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RUBY RIVER RESERVOIR OPERATING GUIDE

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RESERVOIR OPERATING GUIDE

RUBY RIVER RESERVOIR

MADISON COUNTY, MONTANA

May 1986

Prepared for

State of Montana
Department of Natural Resources and Conservation
Water Resources Division
Helena, Montana

and

Ruby River Water Users Association
Alder, Montana

By

U.S. Department of Agriculture
Soil Conservation Service
Snow Survey and Water Supply Forecast Unit
Bozeman, Montana

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INTRODUCTION

INTRODUCTION

Request for Guide

The Water Resources Division of the Montana Department of Natural Resources and Conservation (DNRC) and the Ruby River Water Users Association (RRWUA), operator of the reservoir, requested a reservoir management operating guide for Ruby River Reservoir. This water storage facility provides water to irrigate 29,330 acres and provides supplemental water for another 12,135 acres. The RRWUA also provides free-flow water when available. The RRWUA has 86 contract holders representing 178 contracts. This guide provides information and techniques to assist RRWUA and DNRC make water and reservoir management decisions according to the water supply forecasts and other constraints relative to reservoir releases, reservoir elevations, and downstream water uses.

Ideal Operation

Melting winter snowpack in spring and early summer and spring rain are the primary sources of water. Flows into the reservoir vary greatly, depending on the amount of water accumulated in the mountain snowpack, temperatures during snowmelt, and spring precipitation. Daily fluctuations below the dam are moderated somewhat by storage in Ruby River Reservoir.

Ideal reservoir operation would regulate outflow to prevent or minimize the flow of water through the spillway channel, minimize erosion and downstream flooding, satisfy downstream water uses and rights, provide water for recreation and fisheries needs, and allow the reservoir to fill after the peak runoff occurs and to be full near the end of the high-water period.

Frequently, heavy snowfall and rain occur in May and June and may prevent achieving ideal outflow conditions every year. However, it is possible to base each year's reservoir management on the expected runoff condition by using water supply forecasts based on snowpack, soil moisture, and probable spring precipitation. During heavy snowpack years, downstream flooding can be reduced, and in low snowpack years the effects of low runoff can be somewhat moderated. In all situations the main purpose of the reservoir--providing all of the water contracted--must be given the greatest consideration.

Ruby River Reservoir

Construction of the dam on the Ruby River south of Alder was completed in 1938. The U.S. Geological Survey (USGS) reports the drainage area above the dam is 596 square miles. Elevation ranges from 5,409 feet at the crest of Ruby Dam to 10,545 feet at Black Butte and 10,655 feet at Hogback Mountain.

Ruby River Reservoir is used primarily to supply water for irrigation, but it also provides some recreational use. The reservoir has a useable capacity of 38,850 acre-feet when the water surface is at spillway crest elevation of 5,392.0 feet. The reservoir is usually operated with flashboards in the spillway to an elevation of 5,392.9, thus providing 39,738 acre-feet of storage.

The maximum discharge through the outlet tunnel is about 1,750 cfs when the reservoir is full. However, flows above 450 cfs cause erosion near the outlet.

Reservoir Outflow Considerations

Based on observations by DNRC after the high flows of 1984, the channel downstream from the dam begins to erode when flows exceed about 1,000 cfs. However, the outlet from the dam begins to erode when releases exceed about 450 cfs. There are prior water rights on the Ruby River that predate Ruby River Reservoir and need to be satisfied by reservoir releases. Outflows necessary to satisfy decreed rights and delivery of stored water to downstream users during the main irrigation season are about 350 to 450 cfs.

Releases from the reservoir are critical to fish populations in Ruby River downstream from the reservoir. The downstream fishery is not generally impacted when river flows are kept above 50 cfs below the main canal diversion. Below 50 cfs, impacts become greater as flow levels are reduced. At the beginning of the irrigation season, it is necessary to release more water than is needed for irrigation to keep the river from drying up until return flows reach the main river channel. However, during heavy irrigation withdrawals, there may not be adequate flow left in the river as long as there is a limitation of 450 cfs on the reservoir outflow.

Streamflow and Reservoir Records

The U.S. Geological Survey has maintained a streamgaging station just upstream from Ruby Reservoir since May 1938 and just downstream from Ruby Dam since November 1962. The RRWUA and DNRC also maintain records of water surface levels in the reservoir.

April through July flows at the upstream gaging station have varied from 37,360 acre-feet in 1961 to 164,510 acre-feet in 1984. The 1961-80 average is 84,600 acre-feet. Local inflow between the upstream and downstream gaging stations is estimated to average about 8 percent of the flow at the upstream gage. This figure is based on comparison of historical records for the gaging station above the reservoir and the gaging station below the reservoir adjusted for change in storage in Ruby River Reservoir.

Summaries of reservoir storage and monthly streamflows are given in the Data section. Figure 7 shows the average reservoir storage. The average streamflow hydrograph is shown at the beginning of the hydrograph section in figure 9.

Snow and Precipitation Records

There are six snow courses and three SNOTEL (SNOw survey TELemetry) sites in and adjacent to the Ruby River drainage. Snow survey measurements were initiated at the snow courses between 1962 and 1965. Manual snow depth and

water content readings are made at snow courses three to five times during the snow accumulation period. SNOTEL sites report air temperature, snow water equivalent, and total precipitation daily throughout the year. There is also a proposed SNOTEL site at Short Creek with an elevation of 7,000 feet. There are also two valley climatological weather stations in the drainage where daily observations include maximum and minimum temperatures and precipitation. Location of these stations and average annual precipitation and snowfall are shown in the Maps section. Data from these stations and the report "Hydrology of Mountain Watersheds" was used to construct the elevation versus runoff curve of figure 8. Snow survey and precipitation data are tabulated in the Data section.

RESERVOIR OPERATIONS CURVE THEORY

RESERVOIR OPERATIONS CURVE THEORY

Reservoir Operating Curves

Reservoir operating curves with streamflow forecasts and current reservoir storage are based on the computed inflows to Ruby River Reservoir. Inflows were analyzed to determine how much water could be stored with different rates of outflow. There are two sets of curves--one for use with the April-July forecasts and one for use with the May-July forecasts. These curves are shown in the Operations section, figures 4 and 6.

It should be remembered that the actual reservoir outflow is not set to the value derived from figure 4 or 6 until the inflow reaches this value. For inflows less than the values obtained from figure 4 or 6, the outflow is set equal to the inflow.

Figure 1 helps explain the theory and use of curves and their effect on reservoir levels and outflow. For example, assume the March 1 forecasts are received and it is determined that the present reservoir storage is still below the desired level for the forecasted spring runoff. The reservoir outflow (1) during March is left below the inflow so the storage will continue to increase.

April 1 forecasts are received. After determining the outflow using the April-July curves, the forecasts and current storage, it is decided to leave the outflow the same as during March (1) and continue to increase storage. In figure 1, the outflow remains constant until May 1 forecasts are received.

The May 1 forecasts, May 1 storage, and the May-July reservoir operating curve indicate a higher outflow setting is needed. Gates are opened to a new outflow value (2) on May 11.

The May 15 snow survey data and May 15 storage indicates a higher outflow setting is needed. Gates are opened to a new outflow value (3) on May 24. The volume of water staying in the reservoir as storage is represented by the crosshatched area (4).

The stairstep effect of increasing outflow as new forecasts are received occurs from using smaller than anticipated precipitation values early in the season to assure there is adequate water to fill the reservoir should subsequent precipitation be below average. As time progresses and normal or above-normal precipitation is received, forecasts and outflows are increased accordingly.

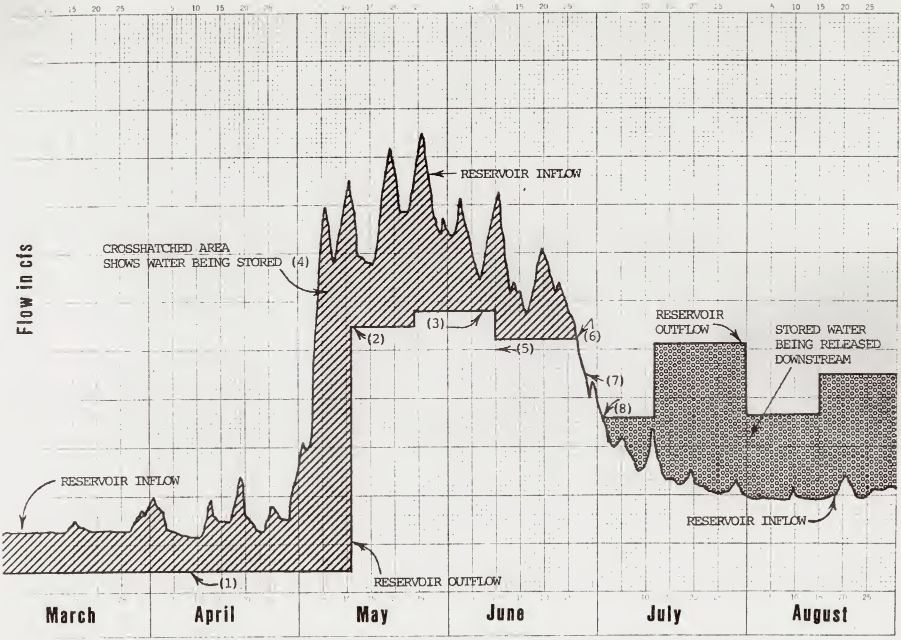

FIGURE 1. TYPICAL INFLOW AND OUTFLOW WHEN RESERVOIR MANAGEMENT IS BASED ON RESERVOIR CURVES AND FORECASTS.

On June 10 (5), it appears the peak runoff has passed and it is decided to reduce the outflow to fill the reservoir sooner. On June 27, the reservoir is filled (6) and outflow is set to equal inflow. This could be sooner or later depending on whether it is a low, average, or high snow year or if the spring precipitation is below, near, or above average. Outflows equal inflows (7) until irrigation demands exceed inflow. Water is then released from storage (8) to satisfy demands through the irrigation season.

Besides determining outflow rates during the main runoff period, early-season forecasts and reservoir operating curves can be used to determine desirable storage levels in the reservoir. When the present storage and forecasted runoff indicate an outflow less than that needed for downstream uses, it would be desirable to increase storage prior to spring runoff. The largest storage level that would be desirable could be determined by reading the storage at the intersection of the forecast and the upper range of the desirable outflow.

Streamflow Forecasts

The SCS issues three separate forecasts for Ruby River above the reservoir near Alder each month. These forecasts are published in the monthly report, *Water Supply Outlook for Montana*, from January through May as "Ruby River near Alder." The Most Probable (MP) forecast is based on the assumption that subsequent precipitation will be near normal. There is an 80-percent probability that the actual runoff will be between Reasonable Maximum (RMX) and Reasonable Minimum (RMN) forecasts. These three forecasts can be used with current reservoir storage and reservoir operating curves to determine outflow settings for the different amounts of forecasted runoff.

Operating Bias

If the amount of spring precipitation were known and the forecast equations were perfect, only one outflow setting based on current streamflow forecast would be necessary. Obviously, this is not possible. The operation of the reservoir must allow for seasons when spring precipitation may be less than or more than normal and for forecast model error. If the outflow is set using average precipitation and then the actual precipitation is below average, the reservoir might not fill or there might not be free-flow water because water released downstream early in the season cannot be brought back upstream into storage. When precipitation is above normal, increased runoff can be passed downstream. However, when large runoff is passed downstream, serious channel erosion, damage to irrigation diversions and canals and/or flooding could result.

To enable the reservoir operator to narrow the range of outflow settings, operating bias curves have been developed. These curves are called bias curves because they represent a bias toward expecting less than average precipitation in low, average and slightly above average years. The bias curves use the following operating criteria to adjust for unknown subsequent precipitation and for forecast model error.

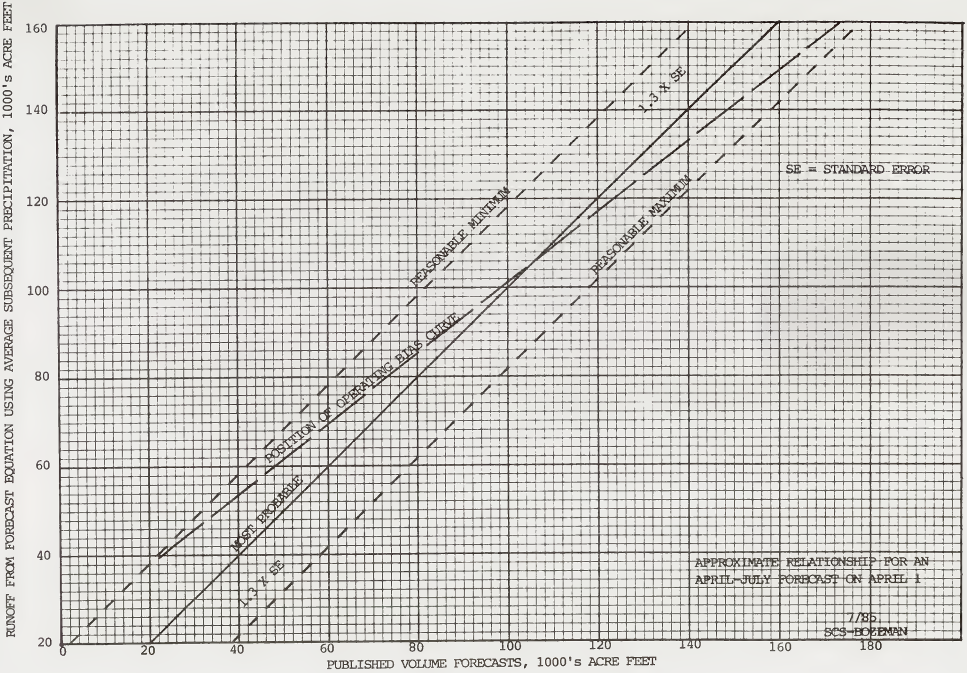

FIGURE 2. RELATIONSHIP BETWEEN RUNOFF FORECASTS AND POSITION OF OPERATING BIAS CURVE

In low snowpack years, the streamflow drops rapidly after the snowpack has melted and provides little opportunity to increase storage if spring precipitation is less than normal and if the runoff is less than forecast. Also, downstream water demands are usually higher in low snowpack years, and filling the reservoir takes longer because water must be released to satisfy downstream needs. The lower portion of the Operating Bias Curve approximates the runoff that can be expected if subsequent spring precipitation is near minimum of record with a low winter snowpack and the projected runoff is near the Reasonable Minimum forecast.

In average snowpack years, streamflow holds up better than in a below-average year because the increased amount of snowpack takes longer to melt and provides more runoff. Even if spring precipitation is lower than normal, some additional runoff can still be stored without seriously affecting downstream uses. The middle portion of the Operating Bias Curve approximates the runoff that can be expected if the snowpack is near average, the subsequent spring precipitation is below average, and the projected runoff is between the Most Probable and Reasonable Minimum forecast.

In high snowpack years, the runoff holds up well even if spring precipitation is quite low. The opportunity to increase storage in the reservoir lasts for a longer period. Also, downstream tributaries have larger runoff and can satisfy some downstream uses. In most cases, it is beneficial to store much of the heavy snowmelt runoff rather than pass it over the spillway because the long-duration, above-average flows downstream can cause extensive channel erosion. The upper portion of the Operating Bias Curve approximates the runoff that can be expected in high snowpack years if spring precipitation is near average and the projected runoff is near the Most Probable forecast.

Figure 2 illustrates how the Operating Bias Curves are developed. Operating Bias Curves for Ruby River Reservoir are shown in the Reservoir Operations section, figures 3 and 5.

Operating Criteria

If outflow obtained by entering Reservoir Operating Curves (figure 4 or 6) with the current storage and either the Operating Bias value from figure 3 or 5, or the Most Probable forecast exceeds about 1,000 cubic feet per second, the operators should consider reducing storage in the reservoir prior to spring runoff to avoid periods of prolonged high outflows during the main runoff period.

If the outflow obtained from the Reservoir Operating Curves on April 1 or later using the Operating Bias Value or Most Probable forecast indicates an outflow between 450 and 1,000 cfs, the operators should consider holding the storage constant until the runoff occurs and declaring free-flow water is available.

If the outflow obtained from the Reservoir Operating Curves on April 1 or later using the Operating Bias value or Most Probable forecast indicates an outflow less than the flow needed downstream during the irrigation season (about 450 cfs), the RRWUA may wish to advise its members that the reservoir may not fill unless spring rains are above average and that free-flow water may not be available and to expect a shortage in the forthcoming stored water supply.

After the peak snowmelt runoff has occurred, operaton of the reservoir will depend primarily on withdrawals to satisfy irrigation and other demands.

Data from Divide SNOTEL site in the upper Ruby River drainage can be used to determine when the snowmelt runoff peak has occurred and when high water will start to recede. Reservoir inflows fluctuate with temperature and usually hold up as long as there is snow in the upper elevations. The seasonal snowmelt peak occurs about the time Divide goes bare or soon thereafter. Inflows start to drop to their summer season low, which usually occurs in August or early September at about 100 to 150 cfs. The time when Divide shows zero snow appears on the hydrographs at the end of the Data section. On low snowpack years, the reservoir operator should try to have the reservoir full prior to the irrigation season. On average or above average snow years, the reservoir operator should try to have the reservoir full shortly after the Divide pillow reaches zero. Also, early season free-flow water may be available. Current values of daily snow water equivalent, precipitation, and temperature from Clover Meadow, Divide, and Tepee Creek SNOTEL sites are available from the SCS field office in Sheridan. This data is also available through direct dial access to SCS central computer in Portland, Oregon.

RESERVOIR OPERATIONS

RESERVOIR OPERATIONS

Data Needs

Once the reservoir operator is familiar with the theory and use of the curves, this section can be used to determine outflow settings for the main runoff period for any amount of forecasted runoff and reservoir storage. Information needed to determine the outflow setting are streamflow forecasts found in the current Montana Water Supply Outlook (WSO) and the current reservoir storage or elevation in Ruby River Reservoir.

Forecasts for Ruby River near Alder are found under Watershed 5, Jefferson River Basin.

Forecasts needed from the WSO are Most Probable (MP), Reasonable Minimum (RMN), and Reasonable Maximum (RMX). The amount of water stored in Ruby River Reservoir can be determined from Table 2, Storage Table for Ruby River Reservoir in the Storage Tables and Outflow section. This value, in acre-feet, needs to be subtracted from the useable capacity (39,837) to determine the volume of water needed to fill the reservoir.

For the April-July runoff forecasts, use the April-July Reservoir Operating Curves, figure 4. For the May-July runoff forecasts, use the May-July Reservoir Operating Curves, figure 6.

Examples of how to use these curves for a low runoff year and high runoff year are shown after figure 6.

Should unusual weather conditions develop after the May 1 forecast, the DNRC or RRWUA may wish to request an updated runoff forecast and/or special assistance from the SCS. Also, SNOTEL data from Clover Meadow, Divide, and Tepee Creek can provide information on how the snowmelt is progressing in the upper elevations. This information can be used by RRWUA to complete filling of the reservoir, provide free-flow water, or provide stored water for downstream uses and help minimize damage to the downstream channel and structures.

Fall and Winter Operation

If storage is low after the irrigation season, the usual practice is to reduce the outflow to a flow less than the inflow. This provides storage through the winter that will be available for use next season. The outflow should be at least 50 to 60 cfs. This will help to maintain sufficient water in the river below the reservoir for stockwater and fisheries.

If there is more water in storage at the end of the irrigation season than desired, two options are available. One option is to leave this water in storage and set the outflow to equal the inflow. During the fall and winter months, the inflow is usually 100 to 150 cfs. An outflow this large may create ice problems in the downstream channel in some years. It may be possible to decrease outflows during extremely cold periods and increase outflows during warmers periods to reduce winter flooding. The other option is to release some of the stored water before freezeup. The first step is to

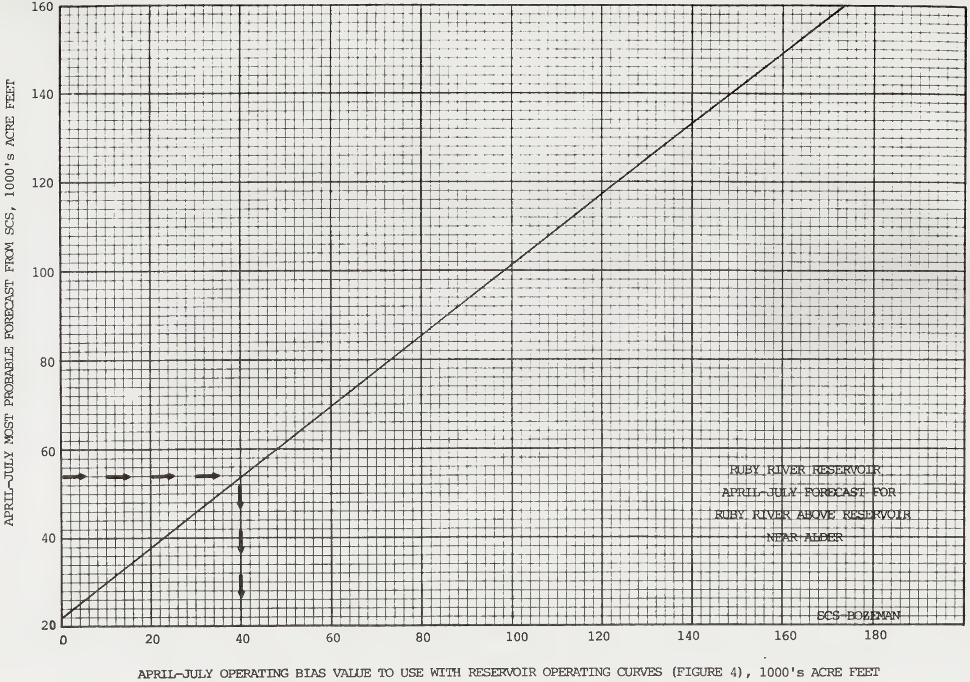

FIGURE 3. OPERATING BIAS CURVE FOR APRIL-JULY FORECASTS

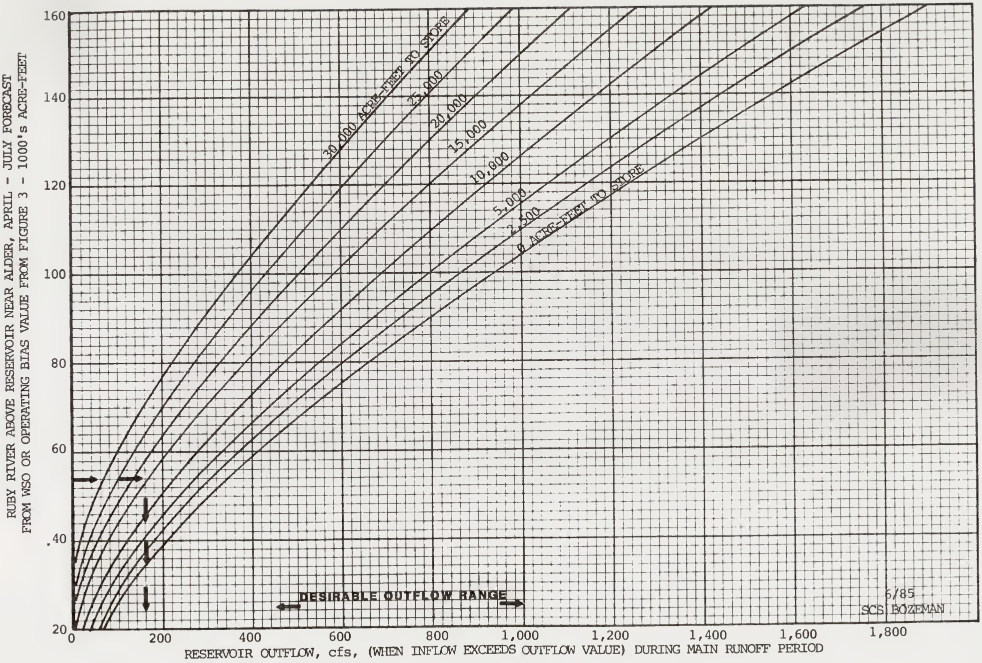

FIGURE 4. RESERVOIR OPERATING CURVES, RUBY RIVER RESERVOIR, APRIL - JULY FORECASTS

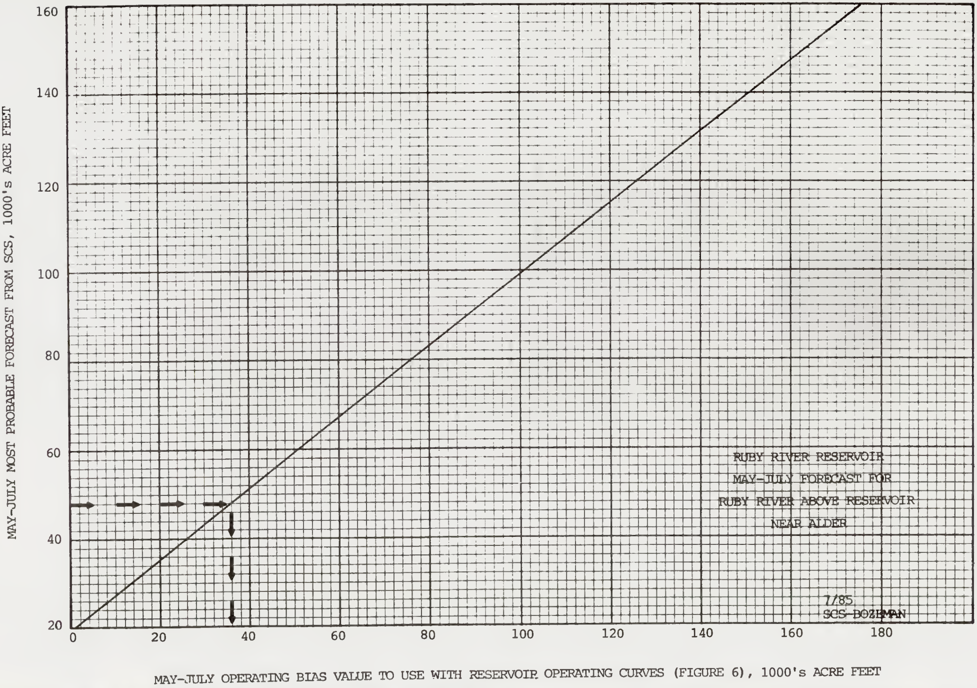

FIGURE 5. OPERATING BIAS CURVE FOR MAY-JULY FORECASTS

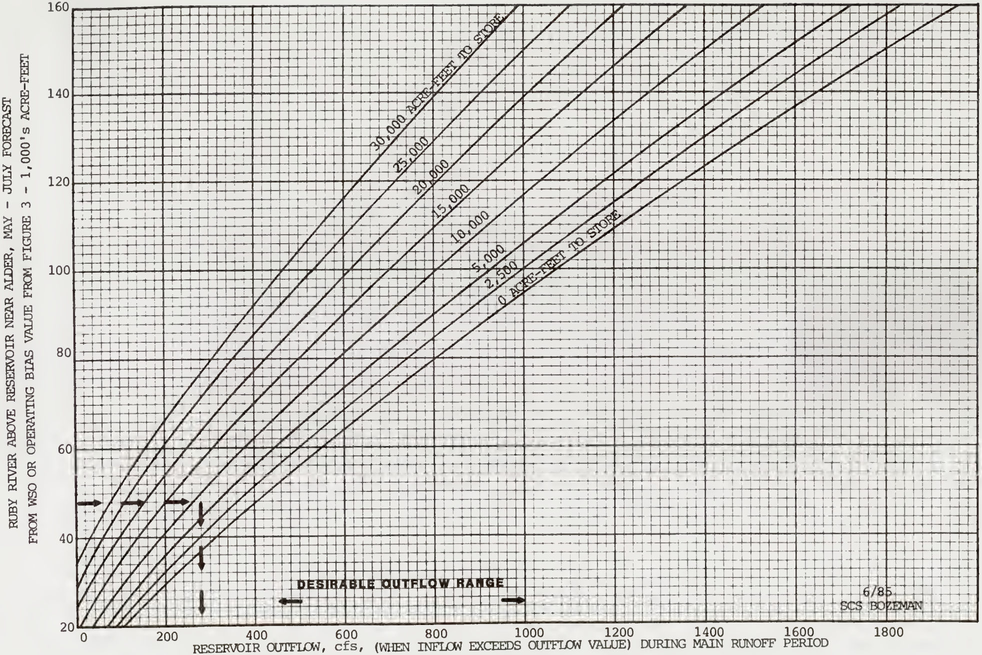

FIGURE 6. RESERVOIR OPERATING CURVE, RUBY RIVER RESERVOIR, MAY - JULY FORECAST

determine the amount of stored water to be released, then divide this amount (in acre-feet) by 1.98347 to convert the storage into second-foot-days (sfd). Next, determine the number of days available for releasing this storage and divide this number into the second-foot-days of storage to be released. This is the daily outflow in cfs needed to release the stored water over the given period. Generally, storage should be reduced prior to mid-November when freezeup usually starts. Reservoir outflow can then be set to equal the sum of the inflow measured at the gaging station plus the computed outflow needed to release the storage. This procedure provides a fairly uniform release which will drop the storage level by the desired amount and minimize disruption in the downstream channel caused by frequent changes in releases or very large releases over short periods.

For example, on September 15, after the irrigation season, the storage in the reservoir is 22,120 acre-feet and it is desired to have the storage down to 16,000 acre-feet before winter and icing conditions develop in the channel (November 15). Assume the reservoir inflow measured at the USGS gaging station above the reservoir is 105 cfs. The storage needs to be reduced (22,120 - 16,000) 6,120 acre-feet or 3,060 second-foot-days (sfd) over a 60-day period. The outflow from the reservoir needs to be set at 51 cfs (3,060 sfd ÷ 60 days) plus 105 cfs inflow or about 156 cfs. If the inflow increases, outflow can be increased accordingly or the reservoir will drop to the desired level a few days after November 15. If the inflow decreases, the reservoir will drop to the desired level a few days earlier than planned. The outflow can be reduced to normal winter operating outflow or around 50 to 60 cfs when reservoir storage is at the desired level.

It is recommended that this reduction be spread over a week to 10-day period to minimize impact on the downstream fisheries. Should the water need to be released in a shorter time, it is recommended that outflows be kept less than 350 cfs to minimize bank erosion and sediment in the downstream channel.

Reservoir Operation Example--Low Year Runoff

March 1 Forecast: Assume the reservoir has 23,700 acre-feet in storage and the MP April-July forecast published in the Water Supply Outlook for Ruby River near Alder is 54,000 acre-feet or 64 percent of average. The RMN forecast is 38 percent of average, and the RMX forecast is 90 percent of average. Average April-July runoff is 84,600 acre-feet.

These forecasts in 1,000's acre-feet can be used to enter figure 4, Reservoir Operating Curves for April-July. RMN and RMX forecasts must be converted from percentages to 1,000's acre-feet by multiplying average April-July runoff (84,600) by the percent of average forecast. This would give an RMN forecast of 32,100 (0.38 X 84,600) and an RMX forecast of 76,100 (0.90 X 84,600).

Subtracting current storage (23,700 acre-feet) from the Useable (39,700 acre-feet) leaves 16,000 acre-feet needed to fill the reservoir.

Enter the April-July Reservoir Operating Curves, figure 4, with 54,000 acre-feet and moving horizontally to the 16,000 acre-feet to fill line shows the outflow would need to be set at 160 cubic feet per second (cfs) during the main runoff period if the runoff is near the MP forecast. This flow is below the minimum desirable outflow (350-450 cfs) for the irrigation season. The RMN forecast indicates outflows would be about 30 cfs if the runoff is near reasonable minimum. If runoff is near the reasonable maximum forecast, the outflow would be about 340 cfs. Entering the MP forecast (54,000) in the Operating Bias Curve (figure 3) indicates the value to use in figure 4 should be 40,000.

The outflow setting would be 70 cfs during the main runoff period based on the Operating Bias value. Since both the MP and Bias curve outflows are less than the minimum desirable outflow for the runoff season, the decision will probably be made to store as much water as possible and leave the outflow at about 50 cfs until April 1 forecasts are received.

April 1 Forecast: Assume that storage in the reservoir was increased by 3,000 acre-feet during March and 13,000 acre-feet are now needed to fill the reservoir. The MP April-July forecast issued by the SCS has been raised to 58,000 acre-feet or 69 percent of average. The RMN forecast is 47 percent of average, and the RMX forecast is 90 percent of average. Converting these percentages to acre-feet would indicate the RMN forecast is 39,800 and the RMX forecast is 76,100.

Entering the April-July Reservoir Operating Curves with MP, RMN, and RMX forecasts and remaining storage (13,000) indicates the outflow during the main runoff period should be set at 220, 90, and 380 cfs, respectively, for MP, RMN, and RMX forecasts. This is well below the maximum desirable outflow for maximum runoff, most probable runoff, and for the minimum forecast. Entering Reservoir Operating Curves with the Operation Bias value (45,000) indicates outflow should be set around 120 cfs during the main runoff period for the reservoir to fill. This is less than desirable and the decision will probably

be made to continue storing as much as possible by leaving the outflow at about 50 cfs until May 1 forecasts are received. At this time the RRWUA or DNRC may want to advise the water users that the reservoir may not fill if rainfall is average or below average and that free-flow water may not be available.

May 1 Forecast: During April, reservoir storage was increased by 3,500 acre-feet, leaving 9,500 acre-feet needed to fill the reservoir. The May-July MP forecast issued by the SCS is 48,000 acre-feet or 64 percent of average. The RMN forecast is 43 percent of average, and RMX forecast is 85 percent of average.

Converting percentages to flow values would indicate the RMN forecast is 32,200 and the RMX forecast is 63,700.

Using May-July Reservoir Operating Curves, figure 6, and 9,500 acre-feet to store, the outflows for MP, RMN, and RMX forecasts would be 280, 140, and 430 cfs. The Operating Bias value (36,000) indicates outflow should be set around 170 cfs after the runoff begins. The decision will probably be made to continue storing all of the water above the 50 cfs outflow until runoff begins or until irrigation demand exceeds inflow. With this low spring runoff forecast, probability of generating channel-damaging flows downstream from the reservoir in excess of 1,000 cubic feet per second is minimal and would be generated only with extremely heavy spring precipitation and then only for a short period.

In low runoff years, when the reservoir does not fill by the beginning the irrigation season, the water users must decide either not to fill the reservoir and use the water for irrigation or to pass up early irrigation and hope that the reservoir will fill later in the season.

Reservoir Operation Example--High Runoff Year

March 1 Forecast: Assume 15,000 acre-feet are needed to fill the reservoir and the MP April-July forecast issued by the SCS for Ruby River near Alder is 102,000 or 121 percent of average. RMN forecast is 95 percent of average, and RMX forecast is 147 percent of average. The computed forecast for RMN would be 80,400 (0.95 X 84,600) and for the RMX would be 124,400 (1.47 X 84,600).

Entering Reservoir Operating Curves, figure 4, with forecasts of 102,000, 80,400, and 124,400 and 15,000 acre-feet left to store shows an outflow of 605,390, and 850 cfs, respectively. Entering the Reservoir Operating Curves with the Operating Bias value (101,000) obtained from figure 3, it would indicate reservoir outflow should be set around 600 cfs when the inflows reach this level. These outflows indicate adequate water will be available to fill the reservoir and satisfy uses but may require some spillway flow since the upper level of outflow is about 450 cfs. The decision will probably be made to hold the reservoir level about the same until the April 1 forecast is received or increase storage slightly.

April 1 Forecast: April-July MP forecast from SCS is now 104,000 acre-feet or 123 percent of average. The RMN forecast is 101 percent of average, and RMX forecast is 145 percent of average. Storage increased slightly and there is now 14,000 acre-feet of storage available. The RMN forecast would calculate to be 85,400 and the RMX to be 122,700. Entering these forecast values in the Reservoir Operating Curves, figure 4, shows outflows of 650, 460, and 850 cfs for the MP, RMN, and RMX forecasts. The Operating Bias value would be 103,000 and suggested outflow would be 640 cfs. The decision will probably be made to declare free-flow water and increase outflow and maintain current reservoir storage until runoff begins. Any significant increase in storage could create the situation of having high outflows if spring rains are above average or temperatures during the early part of the snowmelt period are warmer than normal. Also, by declaring free-flow water before the reservoir fills would provide more irrigation water early in the season, spread out early season demands, and reduce high flows over the spillway that could damage downstream diversions or canals.

May 1 Forecast: The MP May-July forecast from the SCS is 94,000 acre-feet or 126 percent of average. The RMN forecast is 105 percent of average, and the RMX forecast is 146 percent of average. Reservoir levels were held the same so there is still 14,000 acre-feet of storage available in the reservoir. The RMN forecast would be 78,600 and RMX 109,400. Entering the May-July Reservoir Operating Curves, figure 6, with these forecasts and 14,000 acre-feet to store would show outflows of 670, 510, and 820 cfs for MP, RMN, and RMX forecasts. The Operating Bias curve value would be 93,000 acre-feet and figure 6 suggests outflow should be about 660 cfs when the inflow exceeds this flow. The decision will probably be to maintain storage at about the same level until the main runoff period begins. Outflow would probably be increased to equal the inflow until the outflow reaches 450 cfs. The outflow would be left at this amount until the reservoir fills or until weather conditions indicate a change should be made.

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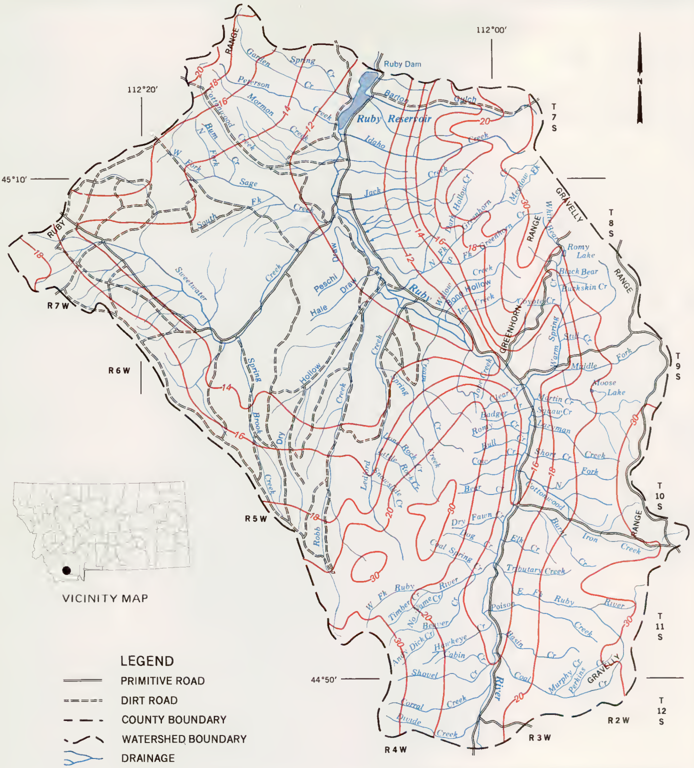
U.S. DEPARTMENT OF AGRICULTURE **SOIL CONSERVATION SERVICE**



LEGEND

═══	PRIMITIVE ROAD
=====	DIRT ROAD
— — -	COUNTY BOUNDARY
. ⁄ ╲	WATERSHED BOUNDARY
～	DRAINAGE
—30—	PRECIPITATION IN INCHES (BASE PERIOD 1941-70)

AVERAGE ANNUAL PRECIPITATION
RUBY RESERVOIR DRAINAGE
PORTIONS OF
BEAVERHEAD AND MADISON COUNTIES
MONTANA

0 1 2 3 4 5 Miles
0 5 10 Km
Approx. Scale

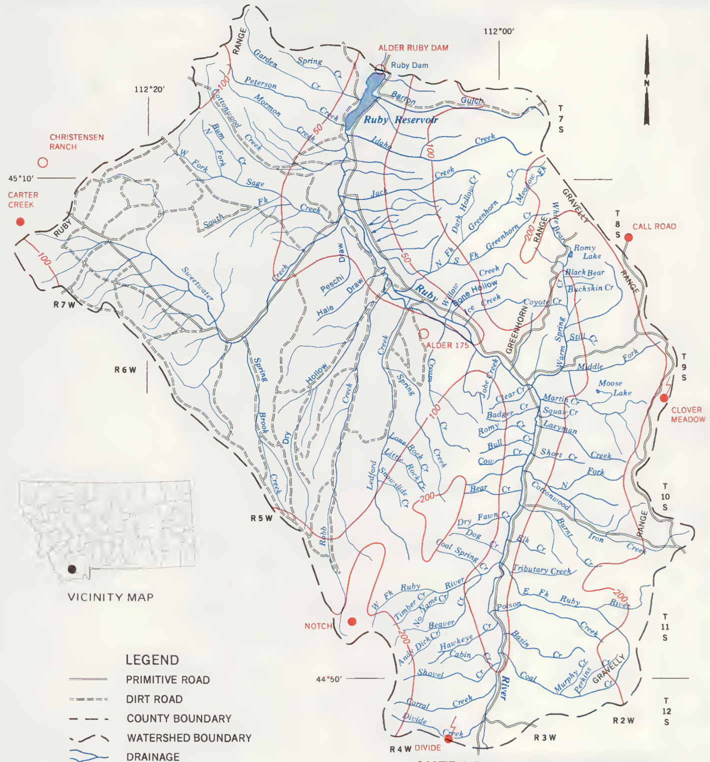
Base Compiled from U.S.G.S. Quadrangles
Planimetric Map. Polyconic Projection

MARCH 1984 4-R-38648-1

USDA-SCS-FORT WORTH, TEXAS 1984

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

PRIMITIVE ROAD

DIRT ROAD

COUNTY BOUNDARY

WATERSHED BOUNDARY

DRAINAGE

—200— SNOWFALL IN INCHES (BASE PERIOD 1958-72)

DATA SITES

● SNOW COURSES

ϟ SNOTEL SITE

○ CLIMATIC STATION

AVERAGE ANNUAL SNOWFALL AND DATA SITES
RUBY RESERVOIR DRAINAGE
PORTIONS OF
BEAVERHEAD AND MADISON COUNTIES
MONTANA

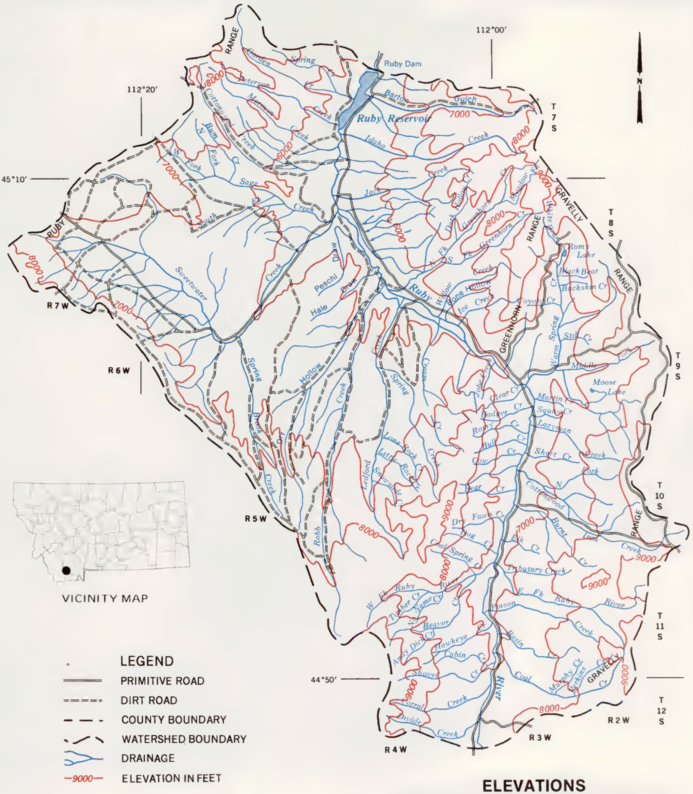
0 1 2 3 4 5 Miles
0 5 10 Km
Approx. Scale

Base Compiled from U.S.G.S. Quadrangles
Planimetric Map. Polyconic Projection

MARCH 1984 4-R-38648-2

USDA SCS-NATIONAL MAPPING DIVISION, FT WORTH, TX 1986

U.S. DEPARTMENT OF AGRICULTURE **SOIL CONSERVATION SERVICE**



ELEVATIONS
RUBY RESERVOIR DRAINAGE
PORTIONS OF
BEAVERHEAD AND MADISON COUNTIES
MONTANA

Approx. Scale

Base Compiled from U.S.G.S. Quadrangles
Planimetric Map. Polyconic Projection

MARCH 1984 4-R-38648

USDA-SCS-FORT WORTH, TEXAS 1984

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TABLE 1
CONVERSION CHART
(Miner's Inches to CFS or Acre-Feet)

Miner's Inches	CFS	Acre-Feet for 24-hr. Period
10	0.25	0.50
20	0.50	0.99
30	0.75	1.49
40	1.00	1.98
50	1.25	2.48
60	1.50	2.98
70	1.75	3.47
80	2.00	3.97
90	2.25	4.46
100	2.50	4.96
200	5.00	9.92
300	7.50	14.9
400	10.0	19.8
500	12.5	24.8
600	15.0	29.8
700	17.5	34.7
800	20.0	39.7
900	22.5	44.6
1,000	25.0	49.6
2,000	50.0	99.2
3,000	75.0	149
4,000	100	198
5,000	125	248
6,000	150	298
7,000	175	347
8,000	200	397
9,000	225	446
10,000	250	496
20,000	500	992
30,000	750	1488
40,000	1000	1983
50,000	1250	2479

Example:

9850 inches = 246.25 cfs

$$\begin{array}{rrl} & 9000 = & 225 \\ + & 800 = & 20.0 \\ & \underline{50 =} & \underline{1.25} \\ & 9850 = & 246.25 \text{ cfs} \end{array}$$

9850 inches for 24 hrs. = 488.18 acre-feet

$$\begin{array}{rrl} & 9000 = & 446 \\ + & 800 = & 39.7 \\ & \underline{50 =} & \underline{2.48} \\ & 9850 = & 488.18 \text{ acre-feet} \end{array}$$

NOTE: 40 miner's inches = 1 cfs
1 cfs for 24 hrs. = 1.98347 acre-feet

TABLE 2. STORAGE TABLE - RUBY RESERVOIR

(Elevations are USGS datum.)

Elev.	Useable Storage (Ac-ft)	Dif. per 10th	Elev.	Useable Storage (Ac-ft)	Dif. per 10th	Elev.	Useable Storage (Ac-ft)	Dif. per 10th
5300	0	6	5340	6,140	33	5380	27,840	90
5301	60	6	5341	6,472	33	5381	28,742	90
5302	120	6	5342	6,804	33	5382	29,644	90
5303	180	6	5343	7,136	33	5383	30,546	90
5304	240	6	5344	7,468	33	5384	31,448	90
5305	300	6	5345	7,800	40	5385	32,350	92
5306	360	6	5346	8,200	40	5386	33,267	92
5307	420	6	5347	8,600	40	5387	34,185	92
5308	480	6	5348	9,000	40	5388	35,102	92
5309	540	6	5349	9,400	40	5389	36,020	92
5310	600	9	5350	9,800	46	5390	36,937	96
5311	688	9	5351	10,260	46	5391	37,894	96
5312	776	9	5352	10,720	46	5392	38,850	99
5313	864	9	5353	11,180	46	5393	39,837	99
5314	952	9	5354	11,640	46	5394	40,824	99
5315	1,040	11	5355	12,100	49	5395	41,811	106
5316	1,148	11	5356	12,586	49	5396	42,869	106
5317	1,256	11	5357	13,072	49	5397	43,927	106
5318	1,364	11	5358	13,558	49	5398	44,984	106
5319	1,472	11	5359	14,044	49	5399	46,042	106
5320	1,580	16	5360	14,530	56	5400	47,100	106
5321	1,740	16	5361	15,094	56			
5322	1,900	16	5362	15,658	56			
5323	2,060	16	5363	16,222	56			
5324	2,220	16	5364	16,786	56			
5325	2,380	20	5365	17,350	62			
5326	2,578	20	5366	17,970	62			
5327	2,776	20	5367	18,590	62			
5328	2,974	20	5368	19,210	62			
5329	3,172	20	5369	19,830	62			
5330	3,370	25	5370	20,450	68			
5331	3,616	25	5371	21,130	68			
5332	3,862	25	5372	21,810	68			
5333	4,108	25	5373	22,490	68			
5334	4,354	25	5374	23,170	68			
5335	4,600	31	5375	23,850	80			
5336	4,908	31	5376	24,648	80			
5337	5,216	31	5377	25,446	80			
5338	5,524	31	5378	26,244	80			
5339	5,832	31	5379	27,042	80			

Rating table from USGS.
Elevation at top of dead storage = 5300.0 feet.
Elevation at crest of spillway = 5392.0 feet.
Elevation at top of flashboards = 5392.9 feet.

TABLE 3. STREAMFLOW RATING TABLE FOR USGS STREAMGAGING STATION
RUBY RIVER ABOVE RESERVOIR NEAR ALDER

GAGE HEIGHT IN FEET	DISCHARGE IN CUBIC FEET PER SECOND									
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2.4	95	97	99	101	103	105	107	110	112	114
2.5	116	118	120	123	125	127	130	132	134	137
2.6	139	141	144	146	149	151	154	156	159	161
2.7	164	166	169	172	174	177	180	182	185	188
2.8	191	193	196	199	202	205	208	211	214	216
2.9	219	222	225	228	231	234	238	241	244	247
3.0	250	253	256	260	263	266	270	273	276	280
3.1	283	286	290	293	296	300	304	307	310	314
3.2	318	321	325	328	332	336	339	343	347	350
3.3	354	358	362	366	370	373	377	381	385	389
3.4	393	397	401	405	409	413	417	421	425	429
3.5	433	438	442	446	450	454	459	463	467	471
3.6	476	480	484	489	493	498	502	506	511	516
3.7	520	524	529	534	538	543	547	552	557	561
3.8	566	571	575	580	585	590	594	599	604	609
3.9	614	619	624	629	634	638	643	648	653	658
4.0	664	669	674	679	684	689	694	699	705	710
4.1	715	720	726	731	736	742	747	752	758	763
4.2	768	774	779	784	790	796	801	807	812	818
4.3	824	829	835	840	846	852	858	863	869	875
4.4	881	886	892	898	904	910	916	922	928	933
4.5	939	945	951	957	963	970	976	982	988	994
4.6	1000	1007	1014	1020	1027	1034	1041	1048	1055	1062
4.7	1069	1076	1083	1090	1097	1104	1111	1118	1126	1133
4.8	1140	1149	1157	1166	1175	1184	1192	1201	1210	1219
4.9	1228	1237	1246	1255	1264	1274	1283	1292	1301	1311
5.0	1320	1330	1339	1349	1359	1368	1378	1388	1398	1408
5.1	1418	1428	1438	1448	1458	1468	1479	1489	1499	1510
5.2	1520	1533	1547	1560	1573	1587	1601	1614	1628	1642
5.3	1656	1670	1684	1698	1713	1727	1741	1756	1771	1785
5.4	1800	1818	1836	1854	1872	1890	1909	1927	1946	1965
5.5	1984	2003	2022	2042	2061	2081	2101	2121	2141	2161
5.6	2182	2202	2223	2244	2265	2286	2307	2328	2350	2372
5.7	2394	2416	2438	2460	2482	2505	2528	2551	2574	2597
5.8	2620	2644	2667	2691	2715	2739	2764	2788	2813	2838
5.9	2862	2888	2913	2938	2964	2990	3015	3042	3068	3094

From USGS Rating Table No. 7.

TABLE 4. STREAMFLOW RATING TABLE FOR USGS STREAMGAGING STATION RUBY RIVER BELOW RESERVOIR NEAR ALDER

GAGE HEIGHT IN FEET	Discharge in cfs	Diff. per 0.1	::	GAGE HEIGHT IN FEET	Discharge in cfs	Diff. per 0.1
0.7	.4	.7	::	4.4	1180	40
0.8	1.1	1.2	::	4.5	1220	39
0.9	2.3	1.9	::	4.6	1259	40
1.0	4.2	3.1	::	4.7	1299	39
1.1	7.3	4.4	::	4.8	1338	40
1.2	11.7	5.8	::	4.9	1378	41
1.3	17.5	7.6	::	5.0	1419	40
1.4	25.1	9.5	::	5.1	1459	41
1.5	34.6	11.6	::	5.2	1500	42
1.6	46.2	14.0	::	5.3	1542	42
1.7	60.2	16.6	::	5.4	1584	42
1.8	76.8	19.5	::	5.5	1626	42
1.9	96.3	22.5	::	5.6	1668	43
2.0	119	26	::	5.7	1711	43
2.1	145	29	::	5.8	1754	44
2.2	174	33	::	5.9	1798	43
2.3	207	37	::	6.0	1841	44
2.4	244	41	::	6.1	1885	44
2.5	285	46	::	6.2	1929	44
2.6	331	50	::	6.3	1973	44
2.7	381	55	::	6.4	2017	45
2.8	436	60	::	6.5	2062	45
2.9	496	66	::	6.6	2107	45
3.0	562	71	::	6.7	2152	46
3.1	633	77	::	6.8	2198	45
3.2	710	50	::	6.9	2243	46
3.3	760	35	::	7.0	2289	46
3.4	795	35	::	7.1	2335	46
3.5	830	40	::	7.2	2381	47
3.6	870	40	::	7.3	2428	46
3.7	910	38	::	7.4	2474	47
3.8	948	38	::	7.5	2521	47
3.9	986	38	::	7.6	2568	47
4.0	1024	38	::	7.7	2615	48
4.1	1062	39	::	7.8	2663	47
4.2	1101	40	::	7.9	2710	48
4.3	1140	40	::	8.0	2758	48

From USGS Rating Table No. 7. Channel work may cause rating to shift until channel stabilizes.

TABLE 5. SPILLWAY FLOW TABLE RUBY RIVER RESERVOIR

Water Surface Elevation (feet)	Flow Through Spillway (cfs)	Water Surface Elevation (feet)	Flow Through Spillway (cfs)
5392.9	0	5395.0	1262
5393.0	14	5395.1	1354
5393.1	37	5395.2	1447
5393.2	69	5395.3	1542
5393.3	105	5395.4	1638
5393.4	147	5395.5	1738
5393.5	194	5395.6	1838
5393.6	242	5395.7	1941
5393.7	297	5395.8	2047
5393.8	355	5395.9	2152
5393.9	416	5396.0	2261
5394.0	479	5396.1	2370
5394.1	546	5396.2	2482
5394.2	616	5396.3	2596
5394.3	688	5396.4	2710
5394.4	763		
5394.5	840		
5394.6	920		
5394.7	1002		
5394.8	1087		
5394.9	1174		

Spillway width = 125 feet.
Elevation at top of flashboards = 5392.9 feet.

DATA - STREAMFLOW, SNOW, AND PRECIPITATION

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TABLE 6. MONTHLY FLOWS RUBY RIVER ABOVE RESERVOIR NEAR ALDER

Water	1000's ACRE-FEET											
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1938								20.60	29.28	12.59	6.02	4.84
1939	6.33	6.04	5.57	4.67	4.55	6.47	10.90	21.11	10.26	6.02	4.07	4.96
1940	5.13	5.22	4.94	5.33	4.81	5.45	7.60	23.29	14.08	6.74	3.64	5.32
1941	6.56	5.64	5.69	5.44	4.84	5.97	6.26	18.00	14.77	5.52	5.06	6.15
1942	6.93	6.25	5.88	4.83	4.40	5.18	14.88	23.57	30.96	12.15	6.22	5.59
1943	6.69	6.52	5.98	4.29	5.20	7.65	10.02	16.04	21.16	8.35	7.78	4.63
1944	6.31	6.46	5.92	5.50	5.29	5.46	7.92	16.31	23.02	11.26	6.81	5.31
1945	6.77	6.33	6.08	5.66	5.65	5.18	5.63	14.81	25.73	11.57	8.06	5.94
1946	6.51	6.73	5.79	5.73	4.77	5.77	13.60	25.94	20.40	8.01	6.09	6.51
1947	8.55	7.33	6.90	6.14	5.93	6.59	8.57	30.77	39.18	13.06	7.32	6.74
1948	7.91	8.04	10.45	9.72	7.73	9.80	15.32	40.49	34.32	15.79	11.25	8.02
1949	9.82	9.05	8.52	7.42	6.45	7.63	12.99	27.62	17.57	8.82	6.09	6.40
1950	8.56	8.29	7.11	6.66	5.64	6.67	9.72	17.67	26.55	12.87	8.14	6.27
1951	7.19	7.47	6.96	6.40	5.60	6.32	8.89	20.39	13.98	6.78	7.27	5.77
1952	6.54	7.24	6.01	6.67	5.95	6.54	12.52	34.65	21.80	10.78	6.95	5.44
1953	5.80	6.69	6.76	6.62	5.66	6.31	6.69	13.68	33.88	10.64	7.27	5.25
1954	5.59	6.78	6.91	6.21	5.35	5.96	7.19	16.28	18.88	8.29	7.07	5.31
1955	6.12	6.27	6.10	5.68	4.88	5.63	6.64	20.06	32.48	10.59	7.26	5.88
1956	5.89	7.09	7.19	6.77	5.70	7.14	8.82	27.62	16.96	6.11	5.54	5.38
1957	5.40	6.70	6.17	5.70	5.17	5.57	6.15	31.81	27.07	11.91	6.50	6.74
1958	7.16	6.68	6.61	6.07	5.30	5.82	6.41	28.18	16.36	9.73	6.00	5.92
1959	6.50	6.84	6.19	5.32	4.85	5.52	7.28	13.68	31.81	10.33	6.64	7.39
1960	9.89	9.03	7.78	7.07	6.32	11.12	13.46	23.04	19.62	6.33	5.50	6.43
1961	6.23	7.30	6.84	6.22	5.55	6.42	6.05	14.67	12.04	4.60	4.40	6.10
1962	7.09	6.83	5.90	4.62	5.69	6.02	17.13	27.54	25.10	11.18	8.60	7.02
1963	6.58	7.15	6.71	5.80	6.07	6.62	7.51	20.30	23.02	8.74	5.99	5.93
1964	5.70	6.59	6.32	5.98	5.63	5.76	7.68	26.01	49.21	18.10	8.33	7.29
1965	6.97	8.06	7.74	6.86	6.00	5.87	9.50	21.89	35.75	17.30	9.31	9.00
1966	7.80	7.05	7.01	6.64	5.62	6.50	8.89	24.08	12.32	6.15	4.66	4.50
1967	6.50	6.81	6.04	5.89	5.26	6.08	6.71	23.56	35.34	18.17	7.14	6.14
1968	7.93	7.95	7.31	6.95	6.29	6.77	7.21	19.44	40.97	13.77	9.34	8.50
1969	8.48	8.27	7.55	7.08	6.50	7.27	14.51	42.68	22.94	15.54	8.56	6.73
1970	9.16	8.65	7.55	7.01	6.45	7.00	8.39	35.71	52.09	17.21	8.96	8.79
1971	9.01	8.31	8.01	7.63	7.50	7.46	10.06	39.55	47.02	19.65	8.95	9.27
1972	9.24	8.61	7.86	7.29	6.47	9.60	10.38	31.57	40.93	16.07	8.97	8.21
1973	7.72	8.27	7.88	6.84	6.07	6.74	10.22	35.20	25.71	9.95	6.75	7.30
1974	7.97	7.90	7.39	6.76	5.83	7.41	10.73	25.83	34.88	12.31	7.78	6.11
1975	7.34	7.54	6.66	6.23	5.58	6.56	6.82	20.26	62.21	29.62	14.45	9.24
1976	9.91	8.69	8.14	7.75	6.43	7.63	12.49	44.68	28.98	14.26	9.17	8.62

TABLE 6. MONTHLY FLOWS RUBY RIVER ABOVE RESERVOIR NEAR ALDER (continued)

Water Year	1000's ACRE-FEET											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1977	8.82	8.07	7.41	6.25	5.88	6.84	12.77	16.65	24.38	9.67	7.31	8.21
1978	5.11	3.97	3.78	3.52	3.87	6.43	7.92	26.80	36.96	19.92	25.11	16.69
1979	8.03	7.59	7.17	6.16	6.21	7.33	8.59	26.68	15.78	7.16	6.78	5.62
1980	6.13	6.79	7.00	6.37	6.05	6.41	11.88	32.92	31.12	12.12	8.40	9.16
1981	8.12	7.38	7.12	6.44	5.76	6.77	11.85	29.91	27.14	8.37	6.74	6.17
1982	7.66	7.19	6.87	6.15	6.65	6.80	10.73	33.06	44.76	23.12	10.45	8.98
1983	9.43	8.41	7.79	7.55	6.53	7.85	10.51	32.33	51.77	27.77	13.40	9.14
1984	11.38	10.56	8.92	8.62	7.38	8.72	12.86	62.10	66.47	23.08	13.80	10.16
1985	9.77	9.08	8.02	7.69	6.37	7.42	13.31	21.52	10.34	4.81	6.34	6.96
1986												
1987												
1988												
1989												
1990												

Data from USGS gaging station.

TABLE 7. SEASONAL FLOWS RUBY RIVER ABOVE RESERVOIR NEAR ALDER
(Data from table 6)

Water Year	1000's ACRE-FEET				
	Apr-Jul	May-Jul	Apr-Sep	Oct-Mar	Oct-Sep
1938		62.5			
1939	48.3	37.4	57.3	33.6	90.9
1940	51.7	44.1	60.7	30.9	91.6
1941	44.6	38.3	55.8	34.1	89.9
1942	81.6	66.7	93.4	33.4	126.8
1943	55.6	45.6	68.0	36.3	104.3
1944	58.5	50.6	70.6	35.0	105.6
1945	57.7	52.1	71.7	35.7	107.4
1946	68.0	54.4	80.5	35.3	115.8
1947	91.6	83.0	105.6	41.5	147.1
1948	105.9	90.6	125.2	53.6	178.8
1949	67.0	54.0	79.5	48.9	128.4
1950	66.8	57.1	81.2	42.9	124.1
1951	50.0	41.2	63.1	39.9	103.0
1952	79.8	67.2	92.1	39.0	131.1
1953	64.8	58.1	77.3	37.8	115.1
1954	50.6	43.4	63.0	36.8	99.8
1955	69.8	63.1	82.9	34.7	117.6
1956	59.5	50.7	70.4	39.8	110.2
1957	76.9	70.8	90.2	34.7	124.9
1958	60.7	54.3	72.6	37.6	110.2
1959	63.1	55.8	77.1	35.2	112.3
1960	62.4	49.0	74.4	51.2	125.6
1961	37.4	31.3	47.9	38.5	86.4
1962	81.0	63.8	96.6	36.1	132.7
1963	59.6	52.1	71.5	38.9	110.4
1964	101.0	93.3	116.6	36.0	152.6
1965	84.4	74.9	102.8	41.5	144.3
1966	51.4	42.6	60.6	40.6	101.2
1967	83.8	77.1	97.1	36.6	133.7
1968	81.4	74.2	99.2	43.2	142.4
1969	95.7	81.2	111.0	45.1	156.1
1970	113.4	105.0	131.2	45.8	177.0
1971	116.3	106.2	134.5	47.9	182.4
1972	99.0	88.6	116.1	49.1	165.2
1973	81.1	70.9	95.1	43.5	138.6
1974	83.8	73.1	97.7	43.3	141.0
1975	118.9	112.1	142.6	39.9	182.5
1976	100.4	87.9	118.2	48.6	166.8
1977	63.5	50.7	79.0	43.3	122.3

TABLE 7. SEASONAL FLOWS RUBY RIVER ABOVE RESERVOIR NEAR ALDER (continued)
(Data from table 6)

Water Year	1000's ACRE-FEET				
	Apr-Jul	May-Jul	Apr-Sep	Oct-Mar	Oct-Sep
1978	94.6	86.7	133.4	26.7	160.1
1979	58.2	49.6	70.6	42.5	113.1
1980	88.0	76.2	105.6	38.8	144.4
1981	77.3	65.4	90.2	41.6	131.8
1982	111.7	100.9	131.1	41.3	172.4
1983	122.4	111.9	144.9	47.6	192.5
1984	164.5	151.6	188.5	55.6	244.1
1985	50.0	36.7	63.3	48.4	111.6
1986					
1987					
1988					
1989					
1990					
1961-80 Average	84.6	74.9	101.4	41.3	142.7
1961-80 Average Inflow*	91.4	80.9	109.5	44.6	154.1

*Inflow to Ruby River Reservoir estimated as 1.08 times Ruby River above Reservoir.

TABLE 8. STORAGE IN RUBY RIVER RESERVOIR

Water Year	STORAGE ON LAST DAY OF MONTH											
	1000's ACRE-FEET											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1960					32.20	33.37	37.04	37.04	30.14	19.81	7.57	4.45
1961	4.90	5.22	13.07	16.22	21.13	27.04	31.45	31.00	17.18	10.26	3.00	1.25
1962	7.80	10.26	16.22	18.59	23.17	28.74	38.85	38.85	38.85	28.74	17.35	9.40
1963	9.40	12.10	15.09	18.59	22.49	27.04	32.35	38.85	38.85	31.45	15.66	7.80
1964	7.80	14.53	19.21	21.13	23.85	28.74	36.02	38.85	38.85	35.10	21.81	14.53
1965	8.60	14.37	18.77	23.17	31.45	28.74	31.45	38.85	38.85	32.35	20.45	16.22
1966	19.21	19.83	23.17	27.04	31.45	35.90	38.85	36.00	28.69	20.42	6.27	7.90
1967	6.90	9.90	16.32	23.17	26.06	29.77	35.10	38.85	38.85	38.85	22.69	9.86
1968	8.53	12.15	16.52	22.45	27.00	30.60	36.00	38.90	38.90	36.90	24.70	19.20
1969	20.50	24.60	27.00	27.80	31.40	30.60	37.90	38.80	37.90	36.90	20.50	8.20
1970	11.20	19.80	23.90	29.60	32.40	36.90	36.90	38.90	38.90	32.40	14.05	9.00
1971	9.00	16.20	20.40	27.00	29.60	31.40	31.50	36.90	38.80	30.60	19.20	13.60
1972	14.00	22.50	26.20	26.20	28.70	32.40	34.20	37.90	38.80	35.10	21.10	13.60
1973	12.59	12.59	16.79	24.65	26.24	29.64	38.85	38.85	37.89	28.74	26.00	23.00
1974	20.00	22.00	23.10	25.69	29.01	30.55	33.54	38.85	39.64	30.28	19.40	14.75
1975	9.80	13.41	17.29	22.15	25.69	29.82	32.72	35.65	38.85	38.85	30.28	16.84
1976	16.34	19.71	21.06	22.97	24.97	31.54	36.20	38.85	38.75	32.42	17.78	11.56
1977	14.64	15.83	17.54	22.15	24.97	30.28	38.85	37.93	38.77	28.20	15.51	10.00
1978	14.32	18.18	22.21	26.16	29.40	31.02	36.52	34.57	32.56	30.42	18.06	13.12
1979	16.91	20.77	24.77	25.46	29.10	31.18	33.52	39.14	30.28	17.10	7.21	1.00
1980	4.97	8.79	13.29	15.14	15.11	24.69	33.86	39.99	32.30	24.03	15.88	15.21
1981	19.26	22.18	25.26	29.04	32.51	36.52	39.80	39.80	39.80	27.17	14.55	6.50
1982	10.54	16.06	21.36	25.99	29.53	32.67	36.39	40.56	41.40	38.28	25.93	14.76
1983	16.91	19.98	22.23	25.69	29.25	32.19	35.47	38.85	40.85	39.08	24.38	17.09
1984	19.14	22.26	25.96	27.77	27.75	33.81	39.64	41.22	40.82	39.22	32.73	18.66
1985	15.69	13.41	18.53	24.09	27.84	33.27	37.80	37.70	26.48	15.45	8.84	7.96
1986												
1987												
1988												
1989												
1990												
1961-80 Average	12.02	15.14	19.63	23.28	26.67	30.33	35.23	37.82	36.12	28.66	17.45	11.83

Data from USGS. Records available from 1938-50. No records for May 1950 through Jan 1960.

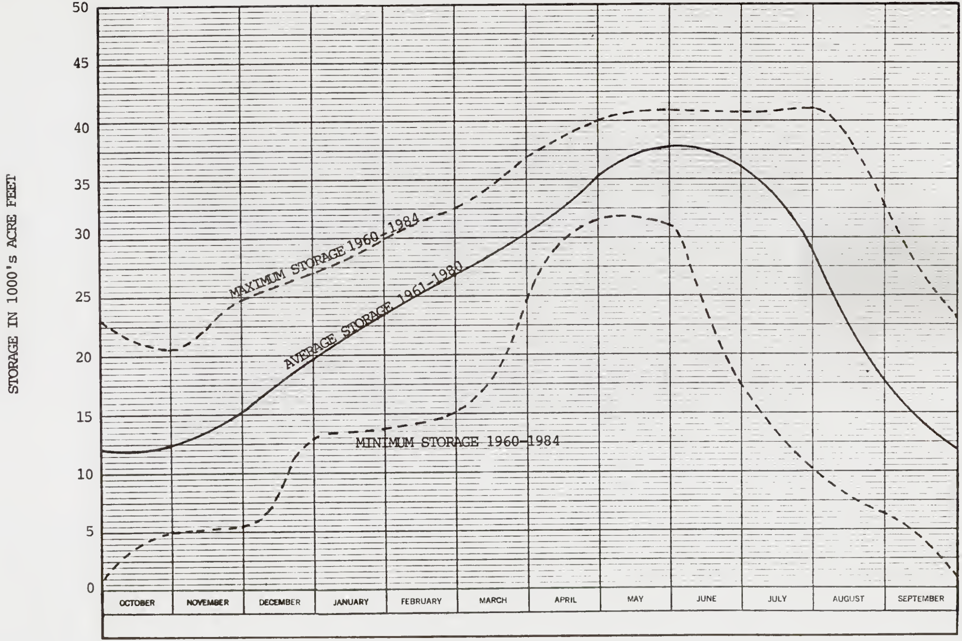


FIGURE 7. STORAGE HYDROGRAPH FOR RUBY RIVER RESERVOIR

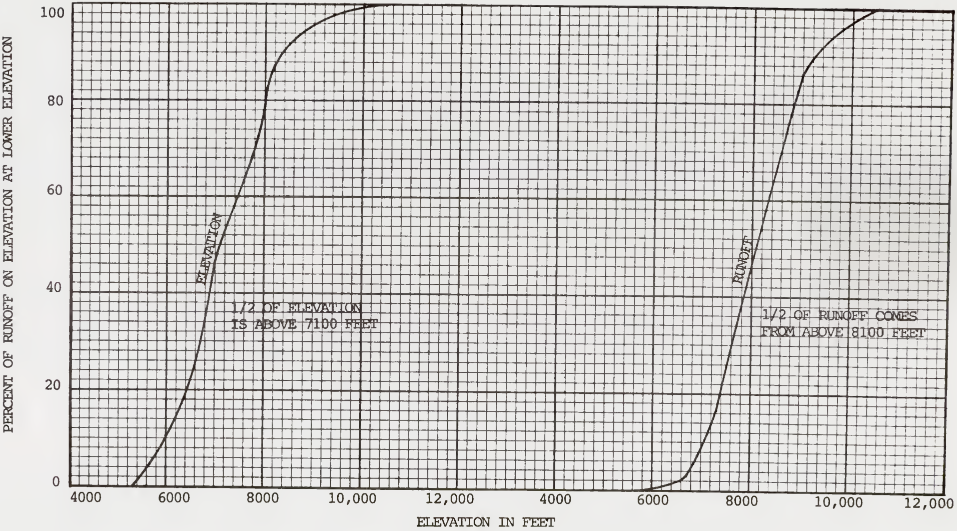


FIGURE 8. RELATIONSHIP BETWEEN ELEVATION AND RUNOFF FOR RUBY RIVER ABOVE RUBY DAM

TABLE 9. CALL ROAD SNOW WATER EQUIVALENT, INCHES

Elevation: 8,050 feet

Location: Sec. 21, T. 08 S., R. 02 W.
Lat. 45° 07' Long. 111° 51'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1962				13.1			
1963			6.8	9.7	12.5		
1964			9.0	12.7	14.2		
1965			12.8	13.9	15.9		
1966			7.4	8.4	11.1		
1967			10.0	14.7	16.0		
1968			11.4	13.0	13.5		
1969			10.0	10.9	9.4		
1970			10.9	14.7	20.1		
1971				17.9	16.6	12.6	
1972			12.1	15.0	16.6	14.8	
1973			8.5	10.7	15.1		
1974			12.6	17.8	16.7		
1975			10.4	14.5	19.6		
1976			11.2	14.5	17.6		
1977			4.8	8.2	4.4		
1978			12.6	13.6	14.4		
1979			10.8	12.4	14.2		
1980			9.0	14.2	11.2		
1981			6.3	9.0	7.8		
1982			9.2	13.1	17.0		
1983			10.2	14.6	14.2		
1984			10.0	13.3	16.2		
1985			7.2	9.7	7.7		
1986							
1987							
1988							
1989							
1990							
1961-80 Average			10.0	13.0	14.2		

TABLE 10. CARTER CREEK SNOW WATER EQUIVALENT, INCHES

Elevation: 7,400 feet

Location: Sec. 22, T. 08 S., R. 07 W.
Lat. 45° 08' Long. 112° 27'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1963			2.6	3.4			
1964			3.6	4.9			
1965		4.5	4.4	7.4			
1966		2.2	2.5	4.2			
1967		3.4		9.4			
1968		3.4	3.6	6.4			
1969		4.2	5.3	5.3			
1970		4.2		8.9			
1971		4.0		7.3			
1972		5.4	6.1	7.4			
1973		4.1	4.0	8.4			
1974		4.6	4.8	6.8			
1975		3.9	4.0	6.3			
1976		4.7	5.2	8.1			
1977		0.9	0.8	4.7			
1978		2.4	2.6	3.4			
1979		3.9	4.5	7.0			
1980		3.0		6.5			
1981		0.2	1.8	4.0			
1982				6.9			
1983		4.3	4.4	7.8			
1984		4.2	4.8	8.6			
1985		3.1	3.3				
1986							
1987							
1988							
1989							
1990							
1961-80 Average		3.4	3.8	6.1			

TABLE 11. CLOVER MEADOW SNOW WATER EQUIVALENT, INCHES

Elevation: 8,600 feet

Location: Sec. 28, T. 09 S., R. 02 W.
Lat. 45° 01' Long. 111° 51'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1963			8.6	13.0	15.4		
1964			12.6	16.8	19.8		
1965			21.7	22.4	24.0		
1966			11.0	12.9	17.0		
1967			14.0	21.7	23.6		
1968			18.2	20.7	21.8		
1969			17.7	19.7	18.8		
1970			14.8	21.1	27.4		
1971			21.5	27.7	27.6	24.1	
1972			17.8	22.1	23.4	19.8	
1973			10.4	15.9	19.5		
1974			16.4	25.0	24.5		
1975			16.0	21.2	29.2		
1976			17.7	22.2	26.0		
1977			6.6	13.0	8.0		
1978			17.6	18.8	20.6		
1979			13.9	14.4	18.7		
1980			12.0	19.1	16.4		
1981			10.2	14.6	16.6		
1982			14.6	19.0	25.4		
1983			14.4	20.0	20.8		
1984			13.2	18.9	21.0		
1985			12.2	16.0	10.8		
1986							
1987							
1988							
1989							
1990							
1961-80 Average			14.6	19.1	21.0		

TABLE 12. CLOVER MEADOW PILLOW SNOW WATER EQUIVALENT, INCHES

Elevation: 8,800 feet

Location: Sec. 28, T. 09 S., R. 02 W.
Lat. 45° 01' Long. 111° 51'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1	Date Max SWE	Max SWE	End Perm Snow Cover
1979	5.9	8.6	12.3	14.3	16.2	14.5	7.4	4/18	17.5	6/10
1980	5.7	9.2	12.7	17.8	14.2	10.8	5.7	4/14	19.0	6/14
1981	5.3	8.2	10.8	14.6	15.1	16.4	12.7	5/23	17.2	6/23
1982	9.4	13.0	15.1	21.7	23.0	22.6	18.3	4/21	25.9	6/30
1983	7.0	8.3	10.3	13.1	13.6	15.0	10.8	5/20	15.8	6/26
1984	10.5	13.0	15.6	20.3	24.9	23.7	15.3	5/08	26.7	6/28
1985	8.2	10.0	11.9	15.4	13.0	7.2	0.0	4/07	15.6	5/25
1986										
1987										
1988										
1989										
1990										
1961-80 Average	7.3	10.4	13.5	17.9	18.2	17.6	12.2	4/29	21.0	6/18

TABLE 13. DIVIDE SNOW WATER EQUIVALENT, INCHES

Elevation: 7,800 feet

Location: Sec. 14, T. 12 S., R. 04 W.
Lat. 44° 48' Long. 112° 03'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1963			6.4	6.8	9.3		
1964			7.8	10.4	12.0		
1965			15.3	15.7	14.7		
1966			7.0	7.6	6.4		
1967			9.8	13.1	14.2		
1968			9.0	10.8	10.5		
1969			15.0	16.2	11.8		
1970			9.3	11.9	13.3		
1971			15.5	19.9	18.8	10.3	
1972			13.1	14.3	13.8	8.0	
1973			8.1	9.8	10.8	0.0	
1974			10.6	16.6	12.8		
1975			8.5	13.6	17.8		
1976			8.7	10.6	13.2		0.0
1977			3.2	5.4	0.0		0.0
1978			11.4	12.2	13.1		0.0
1979			10.2	10.8	10.9		
1980			9.3	12.6	8.2		
1981			5.5	7.4	3.8		
1982			9.8	14.2	18.0		
1983			11.3	15.5	14.0		
1984			9.6	12.5	13.4		
1985			6.0	10.1	3.5		
1986							
1987							
1988							
1989							
1990							
1961-80 Average			9.9	12.0	11.7		

TABLE 14. DIVIDE PILLOW SNOW WATER EQUIVALENT, INCHES

Elevation: 7,800 feet

Location: Sec. 14, T. 12 S., R. 04 W.
Lat. 44° 48' Long. 112° 03'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1	Date Max SWE	Max SWE	End Perm Snow Cover
1976	4.1	6.0	7.9	10.4	13.2	7.3	0.0	5/03	13.2	5/27
1977	1.6	3.5	4.2	6.8	4.4	1.0	0.1	4/19	7.7	6/02
1978	5.0	8.2	11.2	12.4	14.5	9.4	2.2	4/23	15.4	6/05
1979	3.7	5.7	8.9	10.0	10.8	7.9	0.0	4/22	15.4	5/31
1980	3.3	6.0	8.6	11.3	7.8	2.8	0.0	4/13	12.5	5/31
1981	2.8	4.2	6.2	8.2	6.3	5.4	0.0	4/21	8.6	5/26
1982	6.7	9.0	10.3	17.2	19.0	16.6	10.0	4/21	19.6	6/17
1983	6.2	7.7	10.5	14.4	14.1	13.9	2.3	4/19	15.6	6/05
1984	5.8	6.9	8.3	12.0	15.3	12.6	2.4	5/07	26.1	6/17
1985	4.2	5.1	6.4	9.8	8.2	1.0	0.0	4/26	10.1	5/18
1986										
1987										
1988										
1989										
1990										
1961-80 Average	4.4	6.8	9.2	12.2	12.2	8.1	2.1	4/23	14.8	6/02

TABLE 15. NOTCH SNOW WATER EQUIVALENT, INCHES

Elevation: 8,500 feet

Location: Sec. 18, T. 11 S., R. 04 W.
Lat. 44° 53' Long. 112° 08'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1963			7.0	11.3	13.5		
1964			10.8	13.8	16.9		
1965			17.4	17.7	21.2		
1966			12.1	12.7	16.6		
1967			11.9	18.7	20.5		
1968			15.1	16.6	16.8		
1969			17.6	19.6	18.4		
1970			15.6	20.3	25.8		
1971			18.8	24.0	25.6	22.3	
1972			17.3	22.0	24.3	26.3	
1973			10.3	13.9	15.6		
1974			16.9	23.8	24.4		
1975			15.0	20.4	30.8		
1976			14.0	16.0	23.6		
1977			5.8	12.4	10.8		
1978			15.7	17.4	20.1		
1979			11.9	13.2	17.8		
1980			14.0	22.8	18.7		
1981			8.2	12.4	14.0		
1982			12.4	18.4	25.0		
1983			16.2	22.6	25.8		
1984			15.6	20.8	28.0		
1985			9.2	12.9	12.3		
1986							
1987							
1988							
1989							
1990							
1961-80 Average			13.6	17.2	19.6		

TABLE 16. TEPEE CREEK SNOW WATER EQUIVALENT, INCHES

Elevation: 8,000 feet

Location: Sec. 15, T. 12 S., R. 01 W.
Lat. 44° 47' Long. 111° 42'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1
1965				22.7	21.2	19.4	14.1
1966				10.0	11.5		
1967			14.1	17.2	21.9		14.4
1968			12.8	15.0	17.7		
1969		20.0	26.6	25.2	--		
1970	6.2	11.0	13.1	17.6	--		
1971	13.6	17.6	21.0	23.8	--		
1972	--	15.0	17.3	20.2	21.0		
1973	6.4	7.6	9.2	12.2	--	14.1	
1974	8.2	11.4	14.6	20.4	22.4		16.4
1975	6.2	12.0	14.9	19.8	24.8		22.1
1976	9.6	12.6	16.2	19.0	21.0		11.0
1977	1.9	3.2	4.5	7.0	5.0		0.0
1978	8.6	12.0	16.6	18.2	22.6		14.0
1979	5.0	--	13.4	15.5	17.0		
1980	4.4	--	10.1	14.6	11.4		5.8
1981	--	--	8.4	11.4	11.0		
1982	8.8	--	13.9	19.6	22.6		
1983	8.0	--	12.8	20.2	21.2		14.0
1984	8.4	--	11.8	16.1	19.0		
1985	--	--	9.3	15.2	12.3		
1986							
1987							
1988							
1989							
1990							
1961-80 Average	7.3	10.5	13.2	16.3	17.8		10.2

TABLE 17. TEPEE CREEK PILLOW SNOW WATER EQUIVALENT, INCHES

Elevation: 8,000 feet

Location: Sec. 15, T. 12 S., R. 01 W.
Lat. 44° 47' Long. 111° 42'

Year	Jan 1	Feb 1	Mar 1	Apr 1	May 1	May 15	Jun 1	Date Max SWE	Max SWE	End Perm Snow Cover
1972	8.3	12.0	13.8	16.4	17.7	17.8	11.0	5/13	18.0	6/13
1973	5.1	7.0	8.0	10.6	13.0	9.7	2.2	4/27	13.2	6/15
1974	7.3	10.5	12.3	18.5	16.9	13.7	6.7	4/16	18.9	6/10
1975	5.2	8.4	11.9	15.8	19.9	19.7	15.0	5/09	21.2	6/23
1976	7.9	10.3	12.6	14.7	16.7	12.0	0.0	4/30	17.5	6/01
1977	2.0	3.6	4.5	6.1	1.2	0.0	0.0	4/17	6.4	5/13
1978	8.2	12.0	14.7	15.4	19.1	16.0	8.9	4/22	19.1	6/14
1979	5.0	6.7	11.8	13.4	14.5	11.7	2.2	4/28	15.2	6/03
1980	4.3	7.0	9.8	12.0	7.6	2.1	3.8	4/07	12.7	6/11
1981	5.1	6.4	8.9	10.4	7.8	7.6	0.7	4/12	10.7	6/03
1982	7.3	9.7	11.3	18.2	18.7	18.0	12.2	4/18	19.7	6/13
1983	7.5	9.2	13.0	17.3	17.2	17.0	6.6	4/18	18.2	6/14
1984	8.0	9.2	10.6	14.9	16.6	14.0	3.9	5/07	17.3	6/16
1985	5.7	7.1	8.6	11.7	9.4	3.6	0.5	4/07	11.8	5/21
1986										
1987										
1988										
1989										
1990										
1961-80 Average	5.9	8.4	10.7	13.6	13.7	11.5	5.7	4/24	15.5	6/09

TABLE 18. ALDER 17S PRECIPITATION, INCHES

Elevation: 5,850 feet

Location: Sec. 11, T. 09 S., R. 04 W.
Lat. 45° 04' Long. 112° 04'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1957	0.64	0.40	0.54	0.58	0.04	0.50	1.69	2.06	2.03	1.53	1.95	0.60	12.56
1958	1.49	0.34	0.39	0.12	0.27	0.71	0.65	0.50	2.49	1.76	1.51	1.81	12.04
1959	0.01	0.40	0.26	0.09	0.36	0.16	0.36	4.00	3.53	1.23	0.18	2.55	13.13
1960	1.10	0.34	0.12	0.23	0.47	0.49	1.18	1.83	1.25	1.01	1.56	0.34	9.92
1961	0.39	0.20	0.29	0.01	0.41	0.28	0.28	2.14	1.14	0.92	1.54	3.18	10.78
1962	1.31	0.21	0.14	0.94	0.37	0.75	0.53	1.75	1.66	2.29	1.18	0.76	11.89
1963	0.90	1.04	0.00	0.26	0.01	0.42	0.84	1.86	3.91	1.18	0.63	2.30	13.35
1964	0.97	0.58	0.29	0.04	0.12	0.23	1.16	2.16	4.93	0.98	1.80	0.00	13.26
1965	1.06	1.18	0.65	0.37	0.08	0.10	0.66	1.64	2.76	1.76	1.37	2.03	13.66
1966	0.64	0.52	0.38	0.14	0.80	0.29	0.94	2.09	2.02	0.29	0.90	1.56	10.57
1967	0.83	0.93	0.47	0.17	0.17	1.95	0.56	2.31	4.36	3.24	0.22	0.58	15.79
1968	1.80	0.44	0.45	0.75	0.11	0.22	0.70	3.24	1.93	0.44	2.32	1.61	14.01
1969	1.09	1.64	0.20	0.28	0.18	0.13	1.94	1.79	4.52	1.67	1.44	1.43	16.31
1970	1.31	0.69	0.47	0.22	0.00	0.73	1.03	2.64	1.53	1.55	1.68	1.96	13.81
1971	0.55	0.95	0.49	0.23	0.29	0.19	0.64	1.01	2.52	0.43	2.32	1.74	11.36
1972	1.08	0.84	0.35	0.17	0.14	0.31	0.45	1.54	2.95	1.31	1.47	1.40	12.01
1973	1.51	0.59	0.04	0.31	0.12	0.55	0.50	0.81	3.61	0.95	1.57	2.36	12.92
1974	0.71	1.14	0.65	0.19	0.09	0.60	0.24	1.62	0.54	0.56	0.94	0.33	7.61
1975	1.35	0.38	0.86	0.29	0.01	0.37	3.76	2.20	2.29	3.85	1.45	0.23	17.04
1976	1.89	0.56	0.30	0.26	0.12	0.70	1.32	1.38	3.17	1.57	1.24	1.68	14.19
1977	1.03	0.10	0.00	0.64	0.02	1.58	0.29	2.43	2.64	2.37	2.18	3.46	16.74
1978	0.62	0.25	0.60	0.49	0.53	0.07	0.93	1.65	1.64	1.74	0.55	2.27	11.34
1979	0.10	0.64	0.72	0.88	0.65	0.79	0.87	1.21	1.43	0.88	1.06	0.01	9.24
1980	1.51	0.47	0.15	0.50	0.90	0.86	0.66	4.75	1.95	1.35	1.50	3.55	18.15
1981	0.38	0.79	0.15	0.19	0.46	0.62	1.47	3.87	2.60	0.30	0.17	1.07	12.07
1982	1.58	0.20	0.52	0.20	0.33	1.66	0.92	1.97	3.66	2.17	1.35	1.45	16.01
1983	0.99	0.47	0.73	0.07	0.09	0.79	0.64	1.04	3.63	2.71	2.33	1.95	15.44
1984	1.35	1.40	0.79	0.10	0.40	0.93	0.96	1.86	2.96	2.43	2.43	1.18	16.79
1985	1.02	0.33	0.18	0.20	0.10	0.62	0.20	4.18	0.88	1.09	1.35	2.27	12.42
1986													
1987													
1988													
1989													
1990													
1961-80 Average	1.03	0.67	0.38	0.36	0.26	0.56	0.92	2.01	2.57	1.47	1.37	1.62	13.20

Data from National Weather Service Climatological Station

TABLE 19. ALDER RUBY DAM PRECIPITATION, INCHES

Elevation: 5,290 feet

Location: Sec. 08, T. 07 S., R. 04 W.
Lat. 45° 15' Long. 112° 07'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1981					0.86	1.73	1.94	4.91	2.41	0.34	0.27	1.14	
1982	1.64	0.59	0.52	0.46	0.40	1.78	1.37	2.09	2.08	1.10	1.53	1.68	15.24
1983	0.94	0.66	0.90	0.08	1.05	0.89	0.63	1.40	4.22	2.09	2.87	2.08	17.81
1984	2.38	2.81	1.77	0.10	0.65	1.35	1.00	1.71	2.64	2.72	1.84	1.35	20.32
1985	0.93	0.62	0.22	0.25	0.10	0.78	0.46	2.24	0.69	1.09	1.86	2.05	11.29
1986													
1987													
1988													
1989													
1990													
1961-80 Average	1.10	0.71	0.40	0.38	0.28	0.59	0.98	2.06	2.74	1.57	1.46	1.70	13.97

Data from National Weather Service Climatological Station

TABLE 20. CHRISTENSEN RANCH PRECIPITATION, INCHES

Elevation: 6,000 feet

Location: Sec. 34, T. 07 S., R. 07 W.
Lat. 45° 11' Long. 112° 27'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1971									2.62	0.14	0.44	2.20	
1972	1.25	0.53	0.65	0.42	0.42	0.75	1.45	0.93	2.15	0.94	2.05	1.25	12.79
1973	1.31	0.45	0.86	0.40	0.07	1.70	1.43	0.63	2.80	0.53	0.88	0.93	11.99
1974	0.40	1.21	0.74	0.57	0.34	1.09	1.26	2.81	0.40	0.60	0.69	0.40	10.51
1975	1.13	0.32	0.85	0.80	0.50	0.98	1.57	1.21	3.76	3.62	0.48	0.32	15.54
1976	2.33	0.75	0.64	0.36	0.69	0.95	2.45	1.40	3.10	1.23	0.90	3.23	18.03
1977	0.75	0.11	0.07	0.67	0.13	1.64	0.74	2.37	2.36	2.49	0.66	2.32	14.31
1978	0.30	0.35	0.53	0.55	0.58	0.51	1.76	3.54	1.18	2.13	0.82	2.52	14.77
1979	0.29	0.59	0.55	0.71	0.52	0.92	2.60	1.13	0.41	0.95	1.98	0.00	10.65
1980	1.25	0.30	0.10	0.69	1.23	1.18	0.70	6.50	1.90	1.60	1.30	2.70	19.45
1981	1.25	0.20	0.20	0.25	0.50	0.70	1.10	6.40	1.80	0.75	0.55	1.45	15.15
1982	1.70	0.30	0.90	0.30	0.40	1.70	1.00	2.85	2.30	2.20	1.95	2.30	17.90
1983	0.20	0.00	2.00	0.10	0.15	1.00	0.90	0.60	4.75	3.10	3.45	1.75	18.00
1984	1.65	0.70	0.90	0.15	0.50	1.00	1.00	0.85	2.25	1.75	3.15	0.30	14.20
1985	1.00	0.40	0.20	0.25	0.15	0.70	0.25	2.30	0.00	1.70	0.80	2.25	10.00
1986													
1987													
1988													
1989													
1990													
1961-80 Average	1.10	0.40	0.70	0.40	0.40	1.00	1.30	2.30	2.10	1.60	1.40	1.40	14.10

Data from Art Christensen Ranch

TABLE 21. CLOVER MEADOW PRECIPITATION, INCHES

Elevation: 8,800 feet

Location: Sec. 28, T. 09 S., R. 02 W.
Lat. 45° 01' Long. 111° 51'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1977										3.7	4.5	3.4	
1978	1.0	3.3	7.4	5.4	4.9	1.5	6.1	2.8	2.3	1.7	3.8	1.2	41.4
1979	1.0	1.7	3.5	2.2	4.5	2.8	1.2	3.2	3.5	0.9	2.6	0.9	28.0
1980	3.3	1.9	1.7	3.3	3.1	4.8	1.5	5.5	2.5	2.1	2.2	4.7	36.6
1981	2.5	2.1	1.5	2.8	2.4	4.4	3.6	7.0	3.1	0.8	0.7	2.1	33.0
1982	4.4	2.3	3.4	3.4	2.1	6.0	4.9	3.4	2.7	2.9	1.4	4.5	41.4
1983	3.2	2.6	5.7	1.3	3.4	4.9	1.9	4.6	4.5	5.3	2.5	3.8	43.7
1984	2.8	4.6	3.6	2.0	2.7	4.9	5.3	4.3	4.6	3.3	2.2	3.2	43.5
1985	3.5	2.6	1.8	1.6	2.7	3.4	1.4	1.9	2.0	2.9	2.2	3.8	29.8
1986													
1987													
1988													
1989													
1990													
1961-80 Average	2.8	2.8	3.4	3.1	3.4	4.4	3.4	4.3	3.3	2.5	2.3	3.2	38.9

Data from SCS SNOTEL

TABLE 22. DIVIDE PRECIPITATION, INCHES

Elevation: 7,800 feet

Location: Sec. 14, T. 12 S., R. 04 W.
Lat. 44° 48' Long. 112° 03'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1976	2.2	1.9	1.3	1.8	1.5	2.7	4.2	2.4	4.2	1.5	1.3	3.0	28.0
1977	1.3	0.3	0.8	1.9	0.6	2.7	1.2	6.4	5.2	1.1	2.8	4.4	28.7
1978	0.7	1.5	3.4	3.1	3.1	1.4	3.5	1.7	1.6	1.1	0.6	3.2	24.9
1979	0.2	1.5	3.4	2.0	2.5	2.1	1.7	2.2	1.4	1.4	1.9	0.1	20.4
1980	1.9	1.9	1.1	2.7	2.7	2.8	1.4	7.1	2.9	1.3	1.0	3.1	29.9
1981	1.4	1.3	1.6	1.3	2.3	2.2	1.7	4.0	2.8	0.8	0.0	0.2	19.6
1982	3.7	2.7	2.4	2.3	1.4	6.3	3.4	2.3	2.3	3.0	1.1	4.0	34.9
1983	2.3	2.4	3.5	1.6	3.1	4.3	1.1	0.9	3.9	5.5	2.1	2.5	33.2
1984	2.1	4.6	3.0	1.1	1.4	3.7	3.2	2.8	6.7	3.4	4.2	2.0	38.2
1985	2.1	1.7	1.0	0.9	1.3	3.4	0.5	2.4	1.9	0.5	1.0	4.6	21.3
1986													
1987													
1988													
1989													
1990													
1961-80 Average	1.8	2.0	1.8	2.4	2.4	3.2	2.2	3.3	3.4	2.0	1.6	2.6	28.7

Data from SCS SNOTEL

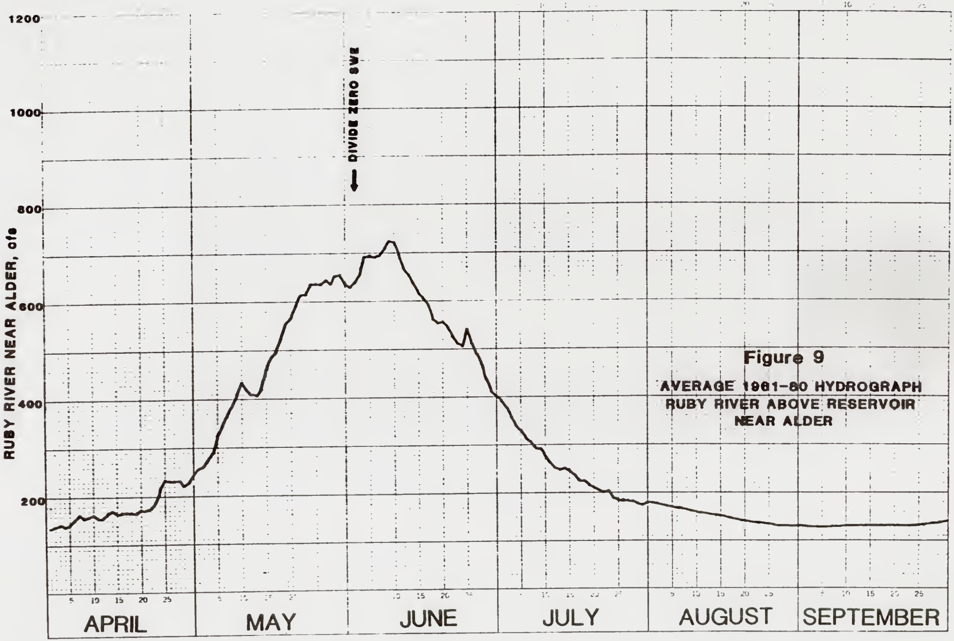
TABLE 23. TEPEE CREEK PRECIPITATION, INCHES

Elevation: 8,000 feet

Location: Sec. 15, T. 12 S., R. 01 W.
Lat. 44° 47' Long. 111° 42'

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1972	2.4	1.9	4.8	7.7	2.4	2.9	3.0	1.8	3.3	1.0	2.0	3.0	36.2
1973	0.5	1.9	4.1	2.9	2.0	2.6	5.3	2.6	3.2	1.7	2.2	2.9	31.9
1974	1.9	3.0	3.2	3.9	1.4	6.0	1.5	2.5	0.8	0.8	0.8	0.1	25.9
1975	0.3	1.2	3.7	3.9	3.9	3.8	5.2	4.5	3.6	2.6	1.7	0.4	34.8
1976	2.6	3.7	2.9	2.5	1.8	4.1	5.0	2.3	4.5	1.8	1.9	3.4	36.5
1977	1.3	0.4	1.0	1.9	0.7	2.0	0.9	4.0	3.4	2.3	2.3	1.8	22.0
1978	0.6	3.7	3.7	3.8	4.0	1.4	4.9	1.5	1.2	1.6	0.5	1.4	28.3
1979	0.6	2.2	3.0	1.7	4.5	2.4	2.2	2.1	0.2	0.2	0.5	0.0	19.6
1980	2.0	2.6	1.2	2.8	2.4	2.7	1.6	6.4	2.3	1.2	2.8	3.3	31.3
1981	0.8	2.5	2.5	1.4	2.8	1.8	2.2	4.2	1.6	3.1	0.4	1.5	24.8
1982	3.3	3.2	3.3	2.6	1.8	6.4	3.0	2.6	1.6	3.7	0.6	3.4	35.5
1983	2.1	2.7	4.7	1.6	3.5	5.1	1.2	0.9	4.8	4.5	3.8	2.6	37.4
1984	3.0	5.9	3.7	1.3	1.5	4.4	2.9	2.8	4.5	4.2	3.5	2.5	40.2
1985	2.8	3.2	2.1	1.6	1.5	3.1	0.6	1.2	1.0	2.1	0.8	4.1	24.1
1986													
1987													
1988													
1989													
1990													
1961-80 Average	1.7	2.7	3.2	2.9	2.5	3.5	2.9	2.9	2.6	2.2	1.7	2.2	31.0

Data from SCS SNOTEL



DIVIDE ZERO SWE

Figure 9

AVERAGE 1961-80 HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

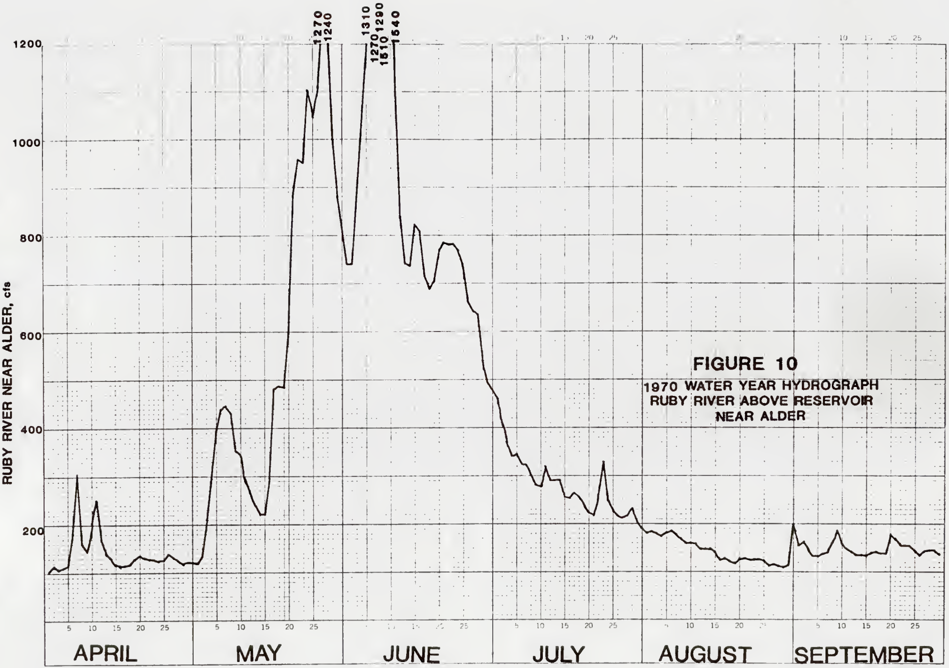


FIGURE 10

1970 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

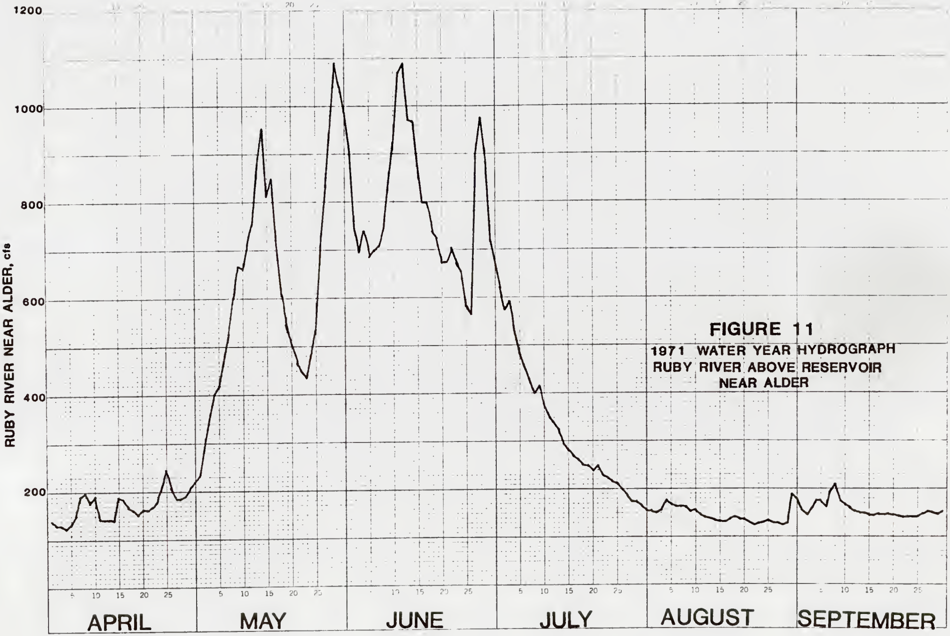


FIGURE 11
1971 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

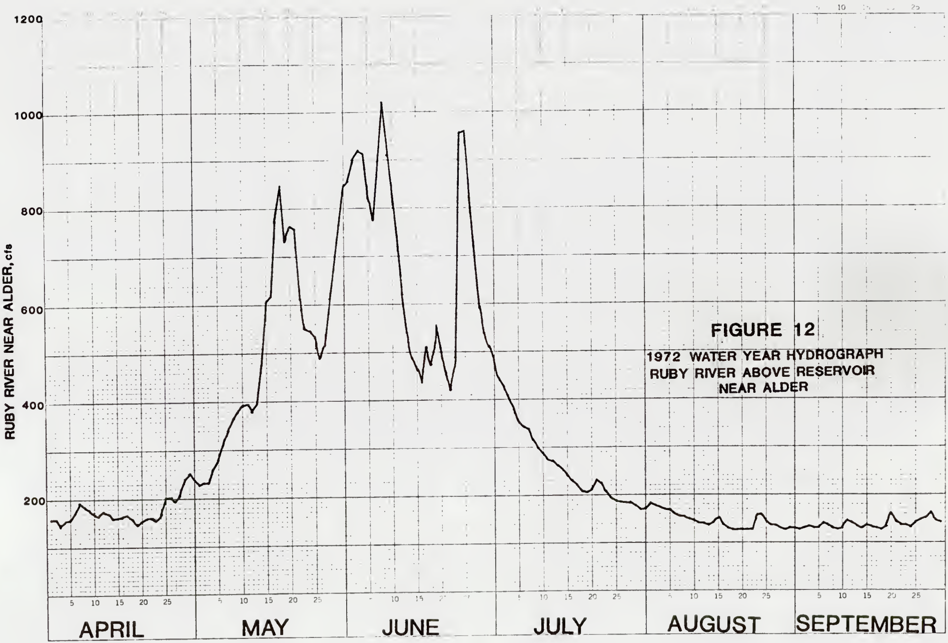


FIGURE 12

1972 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

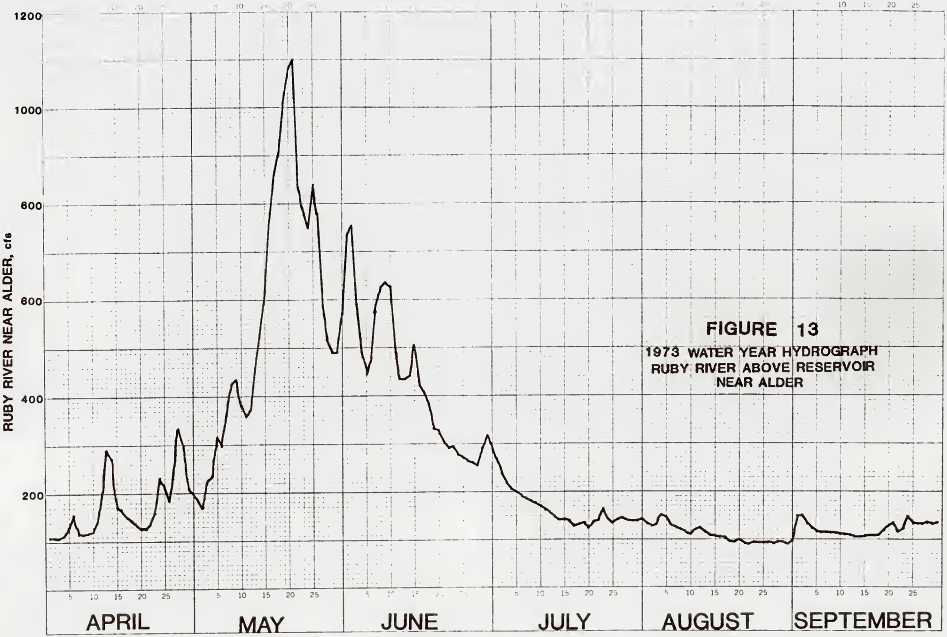


FIGURE 13

1973 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

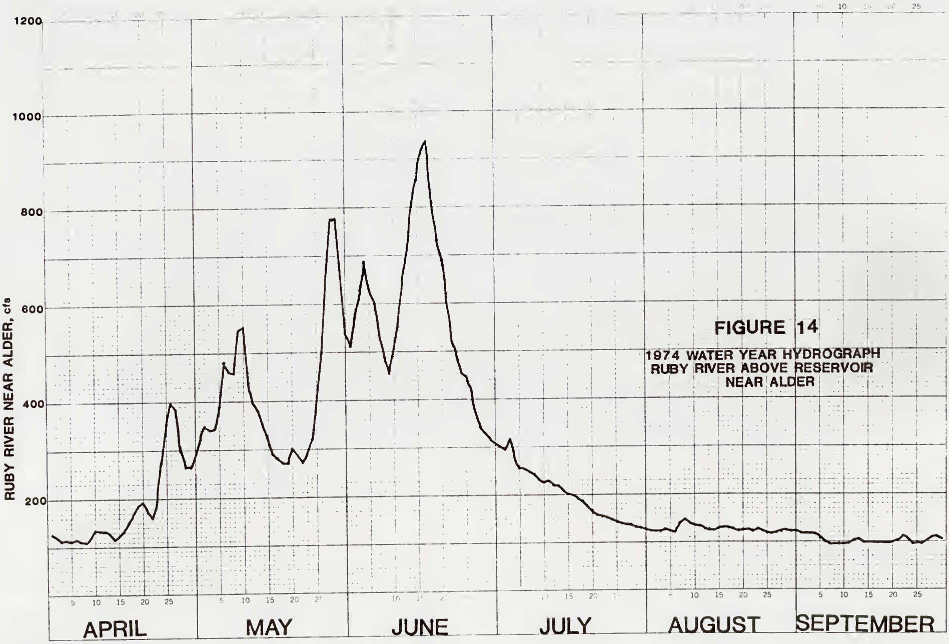


FIGURE 14

1974 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

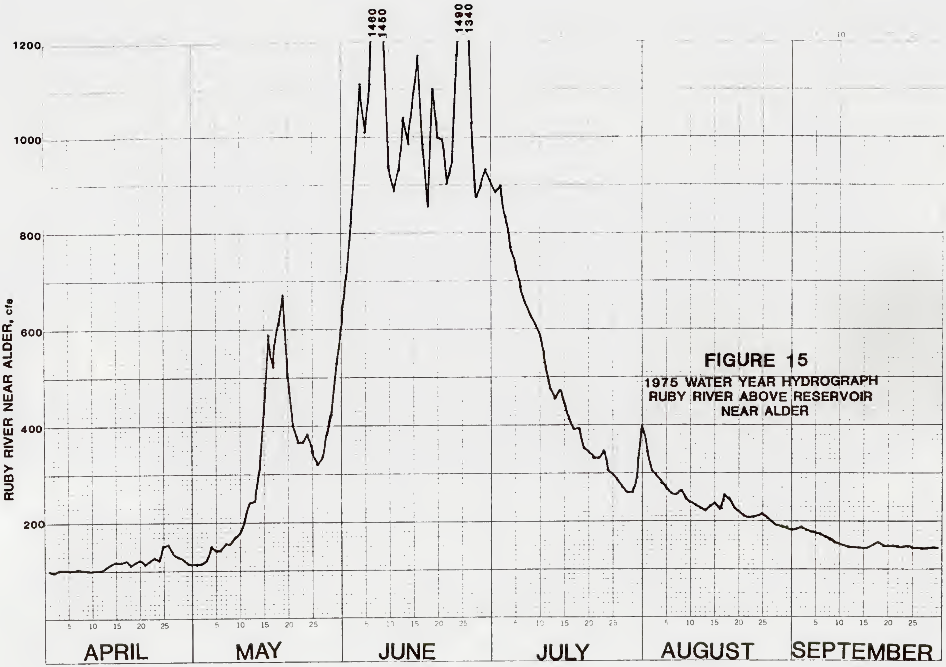


FIGURE 15

1975 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

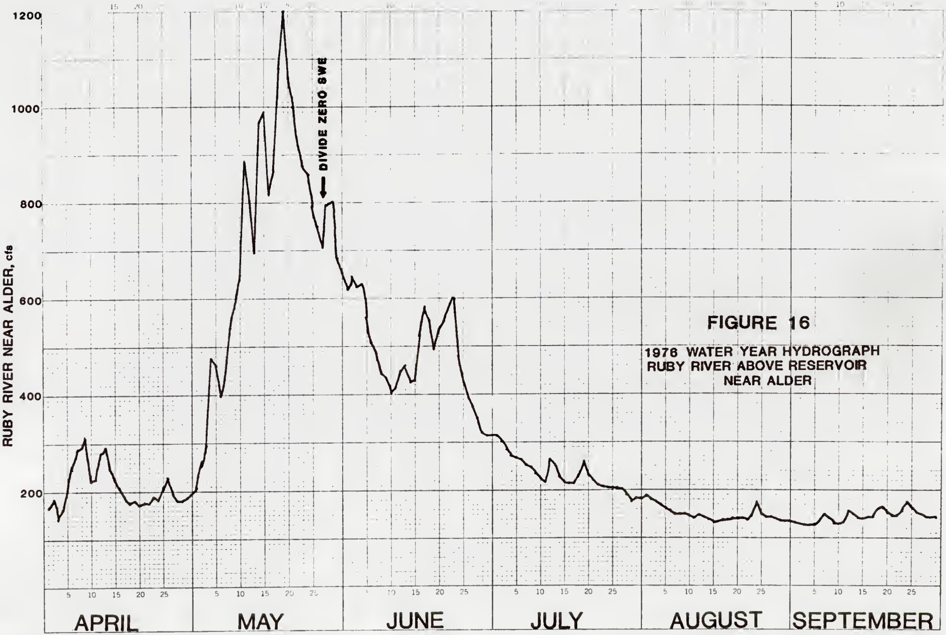


FIGURE 16

1976 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

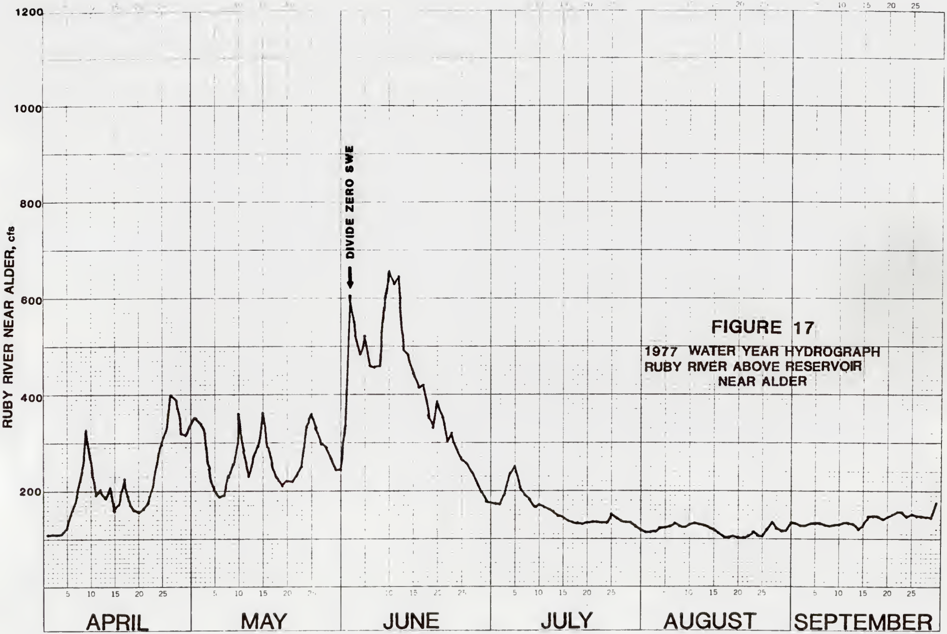


FIGURE 17

1977 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

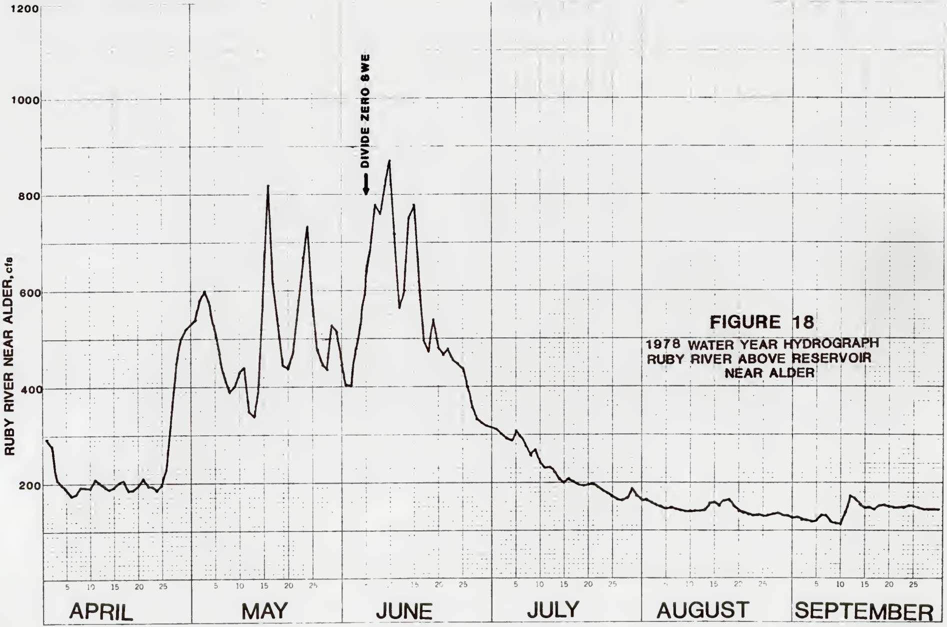


FIGURE 18
1978 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

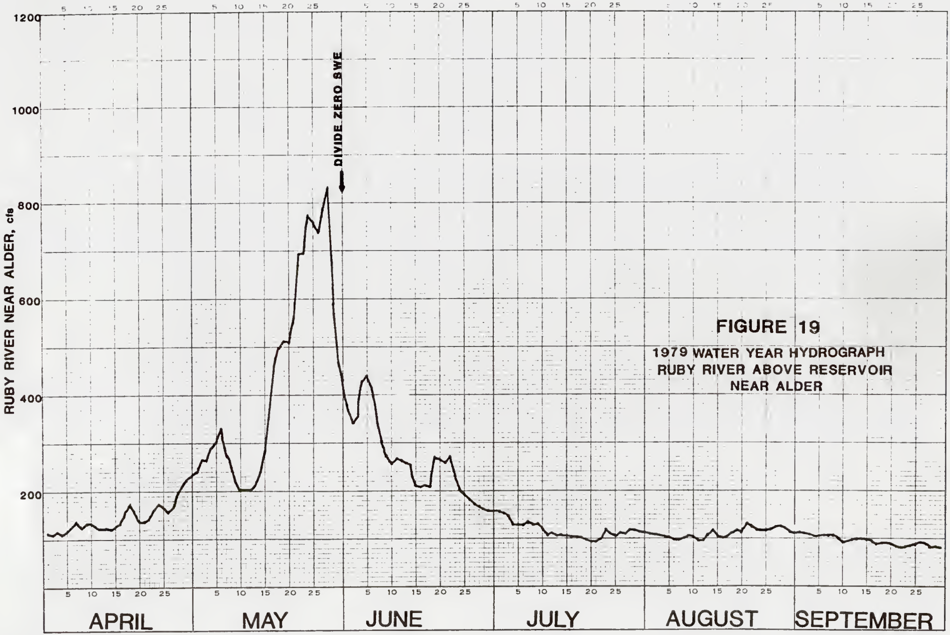


FIGURE 19

1979 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

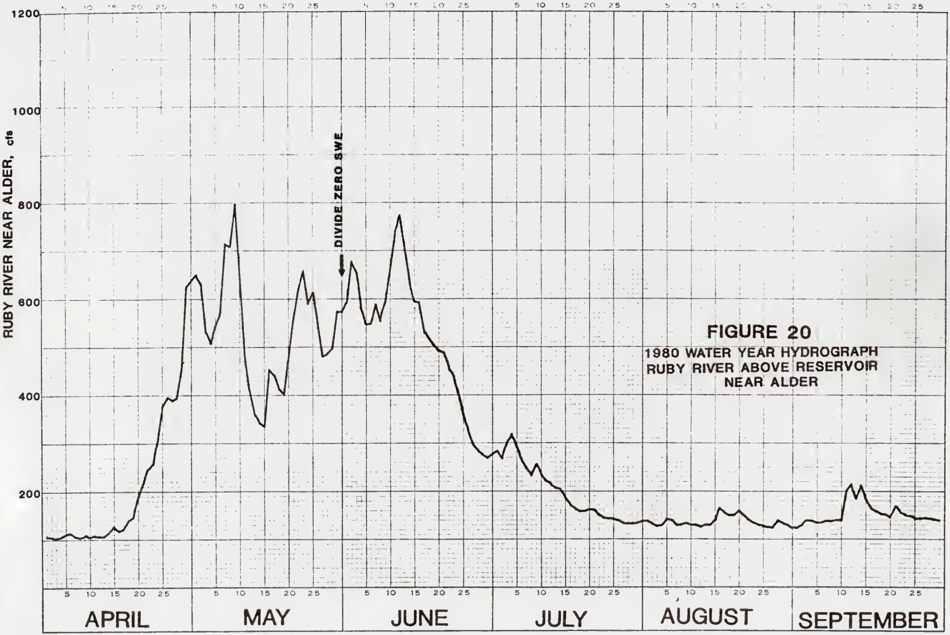


FIGURE 20
1980 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

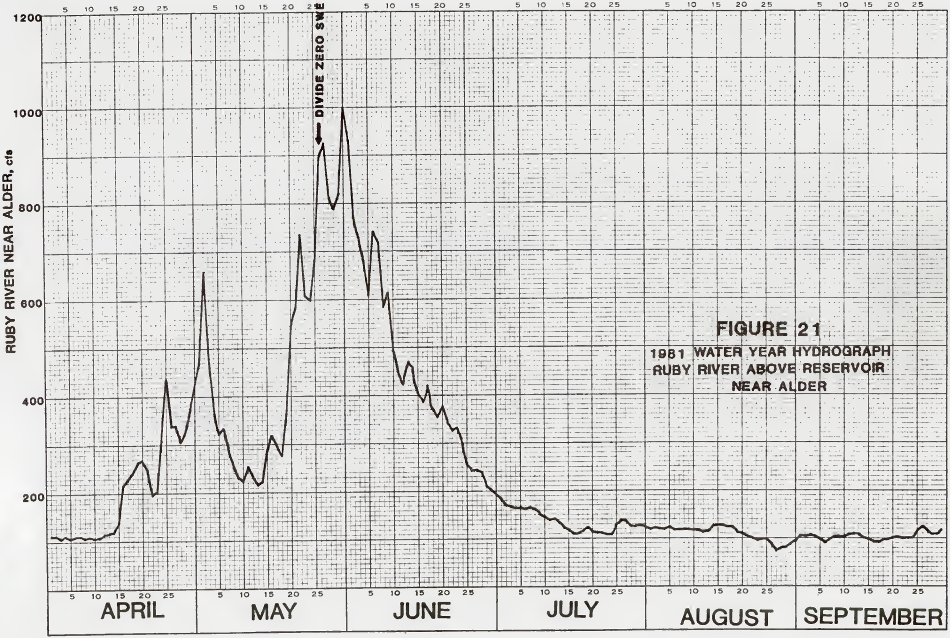


FIGURE 21

1981 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

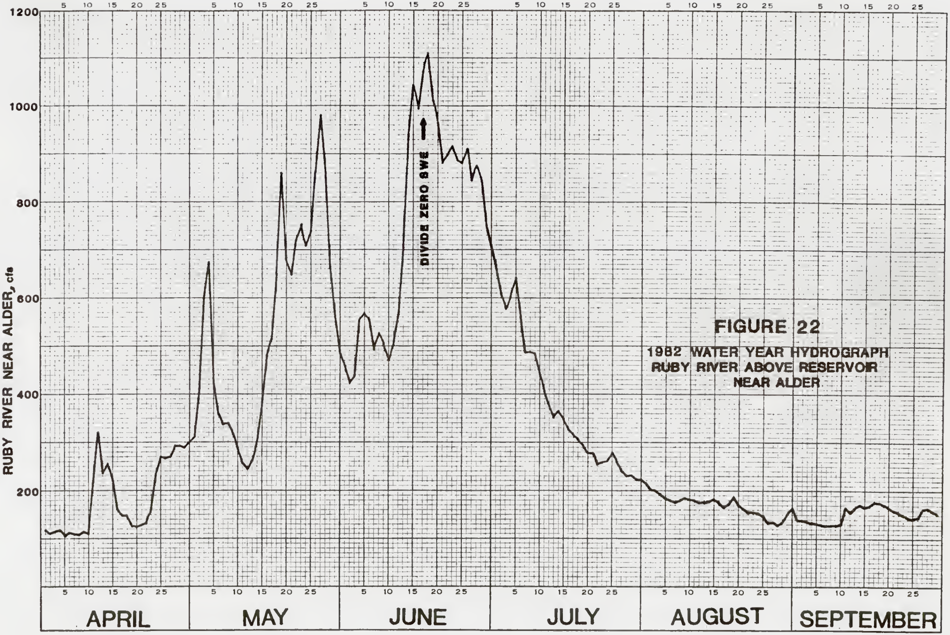


FIGURE 22

1982 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

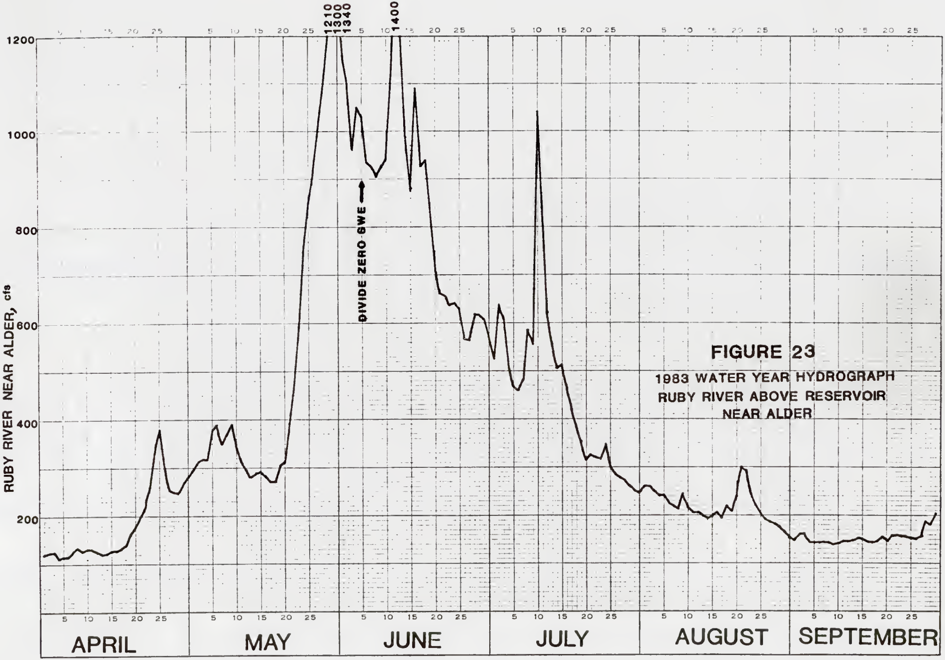


FIGURE 23
1983 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

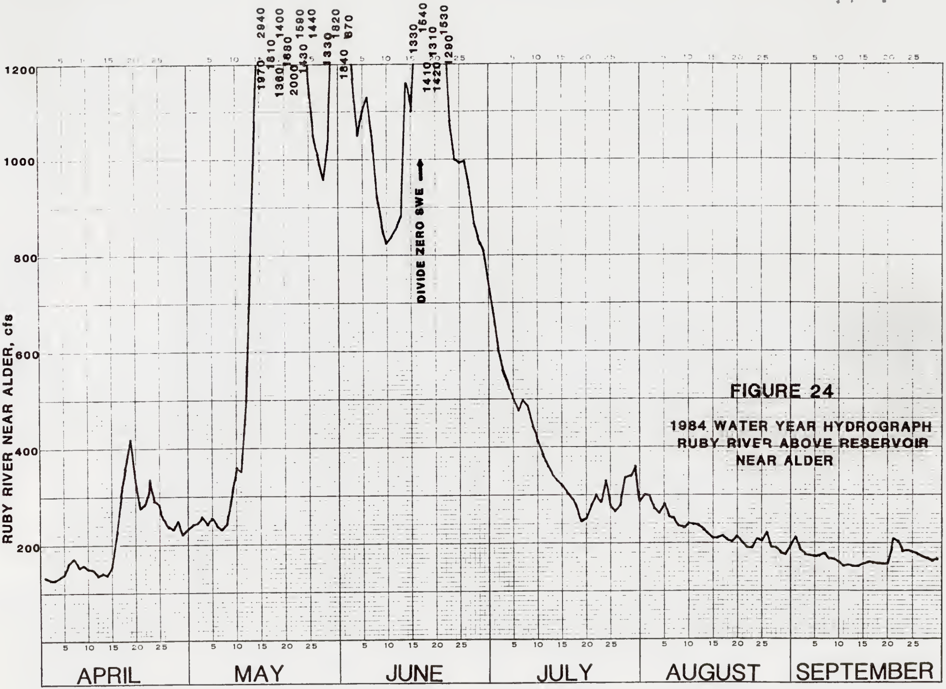


FIGURE 24

1984 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR
NEAR ALDER

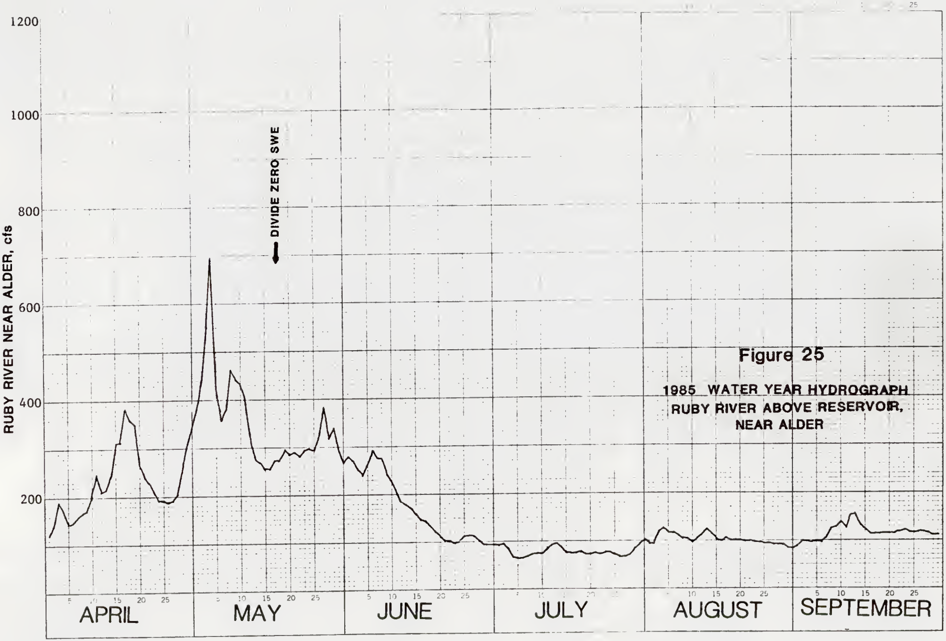


Figure 25

1985 WATER YEAR HYDROGRAPH
RUBY RIVER ABOVE RESERVOIR,
NEAR ALDER

FEDERAL - STATE - PRIVATE

COOPERATIVE SNOW SURVEYS

Furnishes the basic data necessary for forecasting water supply for irrigation, domestic and municipal water supply, hydro-electric power generation, navigation, mining and industry

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"The Conservation of Water begins with the Snow Survey"